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Case Study – Czech Republic

Sustainable Agriculture and Soil Conservation (SoCo Project)

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Case Study Czech Republic

Sustainable Agriculture and Soil Conservation (SoCo Project)

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Preface

Agriculture occupies a substantial proportion of European land, and consequently plays an important role in maintaining natural resources and cultural landscapes, a precondition for other human activities in rural areas. Unsustainable farming practices and land use, including mismanaged intensification and land abandonment, have an adverse impact on natural resources. Having recognised the environmental challenges of agricultural land use, in 2007 the European Parliament requested the European Commission to carry out a pilot project on 'Sustainable Agriculture and Soil Conservation through simplified cultivation techniques' (SoCo). The project originated from close cooperation between the Directorate-General for Agriculture and Rural Development (DG AGRI) and the Joint Research Centre (JRC). The JRC's Institute for Prospective Technological Studies (IPTS) coordinated the study and implemented it in collaboration with the Institute for Environment and Sustainability (IES). The overall **objectives of the SoCo project** are:

(i) to improve the understanding of soil conservation practices in agriculture and their links with other environmental objectives;

(ii) to analyse how farmers can be encouraged, through appropriate policy measures, to adopt soil conservation practices; and

(iii) to make this information available to relevant stakeholders and policy makers EU-wide.

In order to reach a sufficiently detailed level of analysis and to respond to the diversity of European regions, a case study approach was applied. Ten case studies were carried out in Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Spain and the United Kingdom between spring and summer 2008. The case studies cover:

- a screening of farming practices that address soil conservation processes (soil erosion, soil compaction, loss of soil organic matter, contamination, etc.); the extent of their application under the local agricultural and environmental conditions; their potential effect on soil conservation; and their economic aspects (in the context of overall farm management);
- an in-depth analysis of the design and implementation of agri-environmental measures under the rural development policy and other relevant policy measures or instruments for soil conservation;
- examination of the link with other related environmental objectives (quality of water, biodiversity and air, climate change adaptation and mitigation, etc.).

The results of the case studies were elaborated and fine-tuned through discussions at five stakeholder workshops (June to September 2008), which aimed to interrogate the case study findings in a broader geographical context. While the results of case studies are rooted in the specificities of a given locality, the combined approach allowed a series of broader conclusions to be drawn. The selection of case study areas was designed to capture differences in soil degradation processes, soil types, climatic conditions, farm structures and farming practices, institutional settings and policy priorities. A harmonised methodological approach was pursued in order to gather insights from a range of contrasting conditions over a geographically diverse area. The case studies were carried out by local experts to reflect the specificities of the selected case studies.

This Technical Note is part of a series of ten Technical Notes referring to the single case studies of the SoCo project. A summary of the findings of all ten case studies and the final conclusions of the SoCo project can be found in the **Final report on the project 'Sustainable Agriculture and Soil Conservation (SoCo)'**, a JRC Scientific and Technical Report (EUR 23820 EN – 2009). More information on the overall SoCo project can be found under http://soco.jrc.ec.europa.eu.

BE - Belgium	**West-Vlaanderen** (Flanders)
BG - Bulgaria	**Belozem** (Rakovski)
CZ - Czech Republic	**Svratka river basin** (South Moravia and Vysočina Highlands)
DE - Germany	**Uckermark** (Brandenburg)
DK - Denmark	**Bjerringbro and Hvorslev** (Viborg and Favrskov)
ES - Spain	**Guadalentín basin** (Murcia)
FR - France	**Midi-Pyrénées**
GR - Greece	**Rodópi** (Anatoliki Makedonia, Thraki)
IT - Italy	**Marche**
UK - United Kingdom	**Axe and Parrett catchments** (Somerset, Devon)

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Acronyms

AES	Agri-environmental schemes
AOPK	Agency for Nature Conservation and Landscape Protection of CZ
AK	Agricultural Chamber
ASZ	Association of Private Farmers
CIZP	Czech Inspection of Environment
CUZAK	Czech Office for Surveying, Mapping and Cadastre
GAEC	Good Agricultural and Environmental Conditions
LFA	Less Favoured Area
LSU	Lifestock unit
MMR	Ministry of Regional Development
MoA	Ministry of Agriculture
MoE	Ministry of Environment
NGO	Non-governmental Organisation
NVZ	Nitrate Vulnerable Zones
SRS	Plant Protection Authority
UHUL	Forest Management Institute
UKZUZ	Institute of Testing and Supervising in Agriculture
UZPI	Institute of Agricultural and Food Information
VULHM	Research Institute of forestry and game
VUMOP	Research Institute of soil and water protection
VURV	Research Institute of Plant Production
VUV	The T G. Masaryk Water Research Institute, Research Institute of Water Protection
VUZE	Research Institute of Agricultural Economics
ZVHS	Agricultural Water Management Authority

1 Introduction to the case study area

The case study area Upper part of the Svratka River Basin (to confluence with Svitava River) was selected as a case study mainly for its natural conditions and high risk of soil degradation. Relief, geomorphology, the present state of the complex system of soil properties, the types of agricultural farming practices and land use, are all contributing to accelerated soil erosion with all its negative impacts on the environment. A significant part of the river basin area is suitable for the accumulation of water and serves as protection zone of a drinking water reservoir. This dam is a source of drinking water for the city of Brno and other settlements. This makes it very important to find appropriate solutions for the prevention of the soil degradation in the case study area.

After the political changes in 1989 farming in the area went through structural changes, including the transformation of state and cooperative farms to various legal forms. Former cooperatives, family farms, joint stock companies, and limited liability companies emerged in the case study area. Most of the agricultural land is rented; a small proportion is owned by the agricultural firms and individual farmers. The general issue is a highly fragmented land ownership which is under concentrated management by large farms. There is a dynamic process of land consolidation that is managed by a 'Land Settlement Board' (or 'Land office') together with the regional administration, which aims among others at facilitating easier application of landowners' property rights and more efficient land management. The transformation of agriculture led to a decrease of some environmental pressures (e.g. decrease of fertiliser use or livestock numbers) but several driving forces behind soil degradation did not change[5]. For example, in order to keep up with economy of scale farmers maintain large farms and fields, and consequently use heavy machinery while not respecting slopes and other conditions on the field.

The upper part of the Svratka river basin contains hilly areas and highlands with slopes and high altitude plains. The area is located in the middle part of the Czech Republic. The case study area is mostly rural with a high population density (2007: 89 inhabitants/km^2) (Czech Statistical Office, Český statistický úřad 2007). About 42 % of the land is designated as a protected area. Part of the area is designated as Landscape Protected Area (Ždárské vrchy); part of the area is designated as a drinking water protected zone (Vír reservoir dam).

The main soil degradation problems in the case study area are soil erosion caused by water, soil compaction, decline in organic matter, and to a limited extent, diffuse soil contamination.

In brief, the main reasons for the choice of the case study area (see the map of hotspots) are natural conditions in the Case Study area:

- Prone to accelerated soil erosion;
- Significant parts of the river basin serve as protection zones of drinking water reservoir and supply drinking water for the city of Brno and other municipalities;
- Significant area for accumulation of water;
- High recreational potential;
- Intensive soil conservation, especially soil erosion control are needed for protection of Brno Dam and its recreational area (Regional priority);
- Soil conservation perspectives – Complex Land Consolidation process and its support.

Another reason for the case study area selection is the good availability of numerical and graphical especially GIS data for this area from several previous projects.

A large part of the Upper part of Svratka River basin landscape is planned be protected and reconstructed in the course of land consolidation projects. These projects will be based on

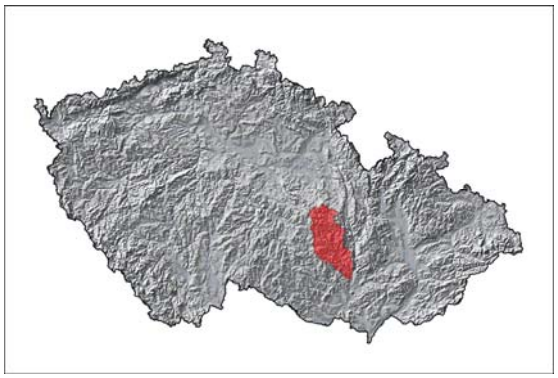
[5] Use of inputs decreased: pesticides from 2,42 to 0,99 kg/ha of active ingredients in years 1985 to 2004; nitrogen: 102,7-72,6 in years 1985-2001; number of cattle (0000): 3506-1582 in 1990-2000. Source: Prazanova, 2005.

new integrated soil-economic units, spatially arranged in a designed multifunctional system of soil conservation measures, such as path network and territorial system of ecological stability, according to structural changes in agriculture. This new approach will be the basis of an economic rational utilisation of the region, which will comply with the present ecological and aesthetic demands.

1.1 Spatial and natural characteristics

The upper part of the Svratka river basin stretches from South Moravia to Czech Moravia highlands. It is situated in the districts (NUTS 3) *South Moravia* and *Vysočina-Highlands.* It covers an area of 1,729 square km. The area features hilly area and highlands with slopes and high altitude plains.

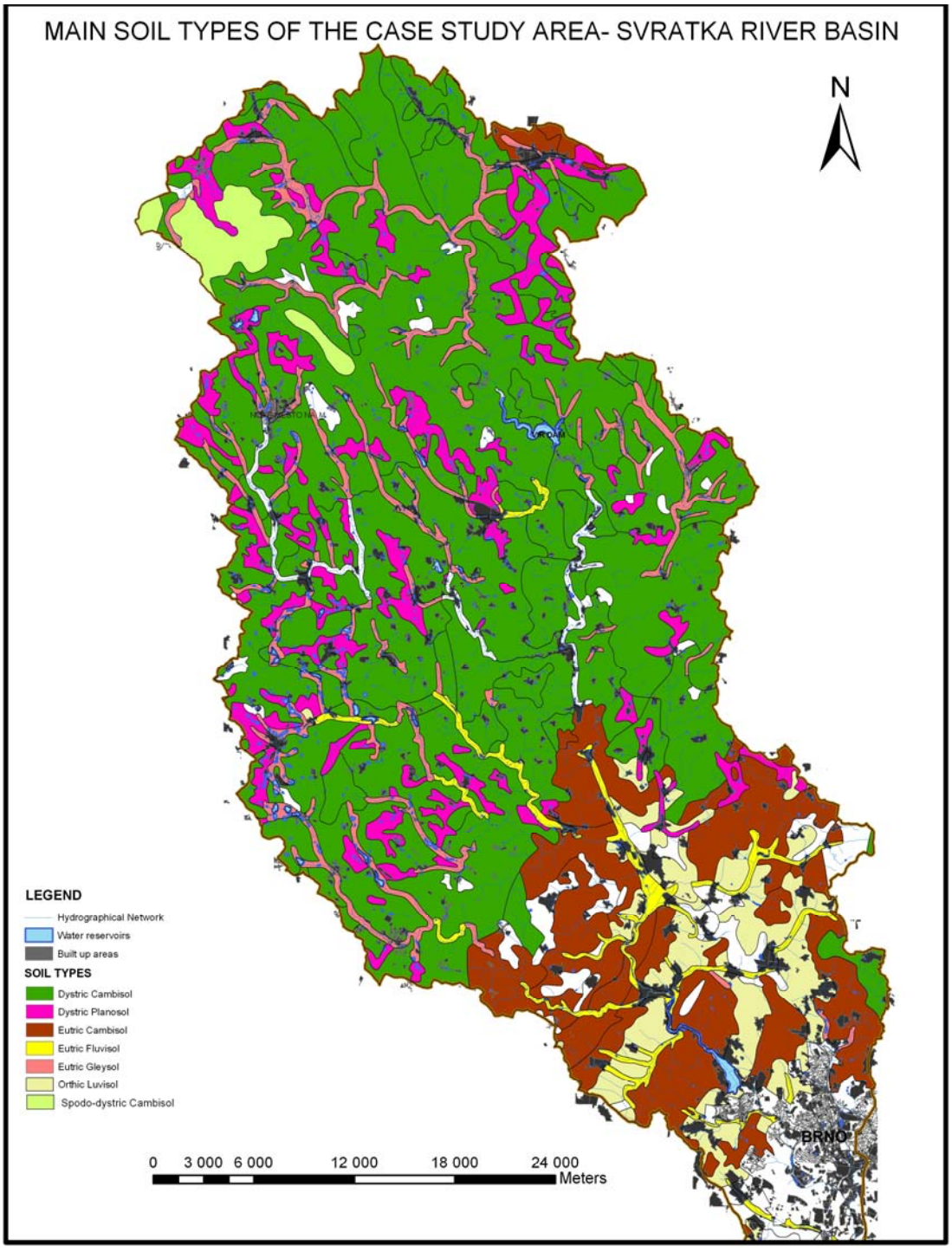
Figure 1: Location of the case study area



Soil types of the Case Study Area

The upper part of Svratka River basin is situated in Czech-Moravian Highlands in crystalline complex. Three main soil types were found over the catchment.

Figure 2: Main soil types of the case study area



The first soil type, which covers about 54 percent mostly slopes of the catchment area, is of the average depth approximately between 60 and 90 cm, and is classified as a Dystric Cambisol with sandy loam and loamy sand topsoil. It consists of black-brown Ah horizon thick 15-20 cm, then 20-25 cm of brown Bv horizon and of 20-50 cm of light brown (to greyish or yellowish) C horizon with increasing amount of the solid particles. The second and third soil types are classified as Eutric Cambisol and Dystric Planosol and covers about 13 respectively 8 % of case study area (see Figure 2 and Table 1).

The prevailing parent rock is weathered paragneiss and erosion products, phyllite, shales, graywacke, granite and their erosion products. The prevailing soil texture includes loamy sand, sandy loam and loam.

The soil texture is suitable for good infiltration rate of soils, Dystric Cambisol, mostly with Forest soils representing an excellent reservoir of ground water, which is easy to be filled due to the high infiltration capacity of forest soils and therefore minimises of surface runoff.

Table 1: Distribution of soil types in the case study area

FAO	area_ha	%
Dystric Cambisol	93,007	53.8
Eutric Cambisol	22,380	12.9
Dystric Planosol	14,523	8.4
Eutric Gleysol	10,440	6.0
Orthic Luvisol	9,728	5.6
Eutric Fluvisol	4,425	2.6
Spodo-dystric Cambisol	3,036	1.8
Albic Luvisol	1,855	1.1
Gleyic Fluvisol	1,636	0.9
Luvi-haplic Chernozem	1,476	0.9
Rendzina	752	0.4
Haplic Chernozem	460	0.3
Mollic Cambisol, Eutric Cambisol	570	0.3
Stagno-gleyic Cambisol	504	0.3
Fluvi-gleyic Phaeozem	284	0.2
Histo-humic Planosol	261	0.2
Albo-gleyic Luvisol	146	0.1
Haplic Phaeozem	165	0.1
Verti-haplic Chernozem, Verti-haplic Phaeozem	218	0.1

Source: Soil Information System of Research Institute for Soil and Water Conservation Prague

Climatic condition of the Svratka River Basin

The case study area is situated in a mild continental climate zone. There are four seasons throughout the year. For spatial distribution of climatic regions see the map of climatic regions of case study area. For a description of the base characteristics see Table 2. On the higher part of the case study area there are Cold-Wet (9) and slightly Cold-Wet (8) climatic regions. The middle part of catchment area represents slightly Warm-Wet (7) and slightly Warm-slightly Wet (5) regions and the Lower part of the case locality (around Brno City) are Warm-slightly Wet (3) and Warm-slightly Dry (2) climatic regions.

Table 2: Climatic conditions in the case study area

Climatic region	Suma of temperature above 10º C	Average annual Temperature (º C)	Average annual precipitation (mm)
2	2600-2800	8-9	500-600
3	2500-2800	(7) 8-9	550-650
5	2200-2500	7-8	550-650
7	2200-2400	6-7	650-750
8	200-2200	5-6	700-800
9	< 200	< 5	800

Source: Bonitation Soil Information System of Research Institute for Soil and Water Conservation Prague, www.vumop.cz

1.2 Land use and farming

The utilised agricultural area (UAA) amounts to 71,010 ha, of which 50,170 ha are arable land, 20,540 ha are grassland; and 297 ha are orchards. Most UAA is concentrated along rivers. Forests cover 64,010 ha. A significant part of the land is cultivated by large farms (cooperatives, limited companies, and civil-law partnerships). The small and medium-sized farms are family farms. The farms are mostly arable farms with the main crops being winter wheat, corn as forage, and barley. There is a low density of livestock mostly consisting of bovine and poultry. A part of the area is designated as landscape protection area (Ždárské vrchy) and another part of the area is designated as drinking water protection zone (Vír reservoir dam).

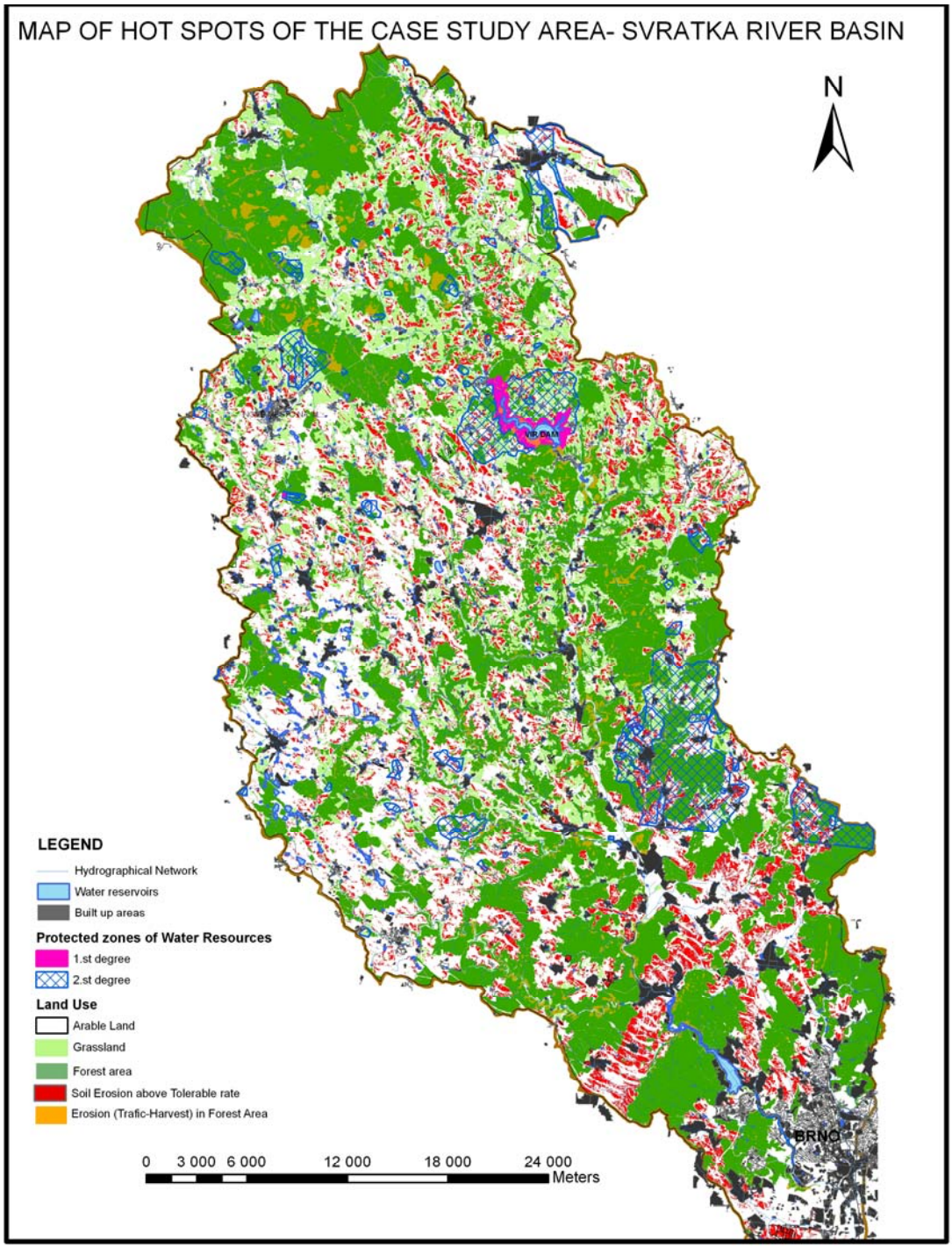
1.3 Main soil degradation problems

The main soil degradation issue in the case study area is soil erosion by water (Figure 3) due to large plots predominantly used as arable land, the hilly landscape and steep slopes in the highlands. Soil erosion is fostered by i) soil degrading (intensive) farming practices such as up and down hill conventional tillage and other conventional agricultural operations on arable land, ii) frequent extreme hydrological events, and iii) a decreasing ability of soils for water retention (decline in organic matter and land conversion). Since the draining system is poorly maintained, hydrological events cannot be sufficiently controlled.

Soil compaction is a problem due to intensive conventional farming on arable land (using heavy machinery) especially in lower part of the case study area (around Brno City).

The decline in organic matter results from the constant soil erosion process. Main causes of decline in organic matter are conventional farming practices without using manure and other organic matter.

Figure 3: Extent of the main soil degradation issues



1.4 Land Tenure system

Most agricultural land is farmed under lease-hold; only small parts are owned by the agricultural firms themselves; there are no commons (Table 3). Highly fragmented land ownership is prevalent in the area. However, there is a dynamic process of land consolidation that is managed by a 'Land Settlement Board' together with the district administration. The 'Land Fund' has been responsible for the management and privatisation of state-owned agricultural and forest land (State owned Land, very small acreage, was sold to individual owners). Within the 'Complex land consolidation', 22 cadastres have been completed and another 17 started.

Table 3: Land ownership

Subject	Amount	%	Area ha
Agricultural joint-stock-company	32	29.87	24,077
Cooperative farms	30	22.56	18,185
Individual farmer	657	18.71	15,083
Agricultural trade-company	19	10.21	8,229
Agricultural school farms	2	0.38	310

Source: Land Parcel Identification System, System for agricultural subsidies in the Czech Republic, not publicly available, 2008

2 Methodology

The Czech Republic's specific context needs to be taken into account in the case study analysis. The ownership structure and management of land in the Czech Republic is a crucial aspect for conclusions about the case study. Most of the land is rented in Czech Republic and the majority of policies referring to soil conservation relate to land managers while only two key policy measures with soil protection implication are primarily targeted at land owners. The ownership structure implies not enough motivation of land managers (both corporate farms and family farms) for long term considerations related to soil protection. This is the reason for the low effectiveness of the long-term and/or costly measures.

The study is based on the analytical framework as defined in Deliverable 1.2, Interim Report 1.

Survey:

In order to collect relevant data on soil conservation in the Czech Republic and the case study area in particular a survey was organised. According to Questionnaire 1 data on soil and farming practices was collected by a soil protection expert and as an output an excel sheet was produced. Farmers in the case study region were interviewed (semi-structured interviews) according to Questionnaire 2 (e.g. attitudes regarding the policies, farming practices adopted). These interviews were conducted also by a soil conservation expert. Farms were visited and all interviews were performed face-to-face.

Questionnaire 3 focused on state administrators and helped to collect information on soil conservation policies, authorities and stakeholders involved, policy design, implementation and evaluation. Similar information was collected from stakeholders (non-governmental type of organisations) in the framework of the Questionnaire 4. Most of the interviews were conducted face-to-face; only two interviews were conducted over the telephone. Questionnaires were considered as too long by the interviewees, but in most cases it was possible to tailor the content of the questionnaires to the specific characteristics of the interviewees, thereby shortening the interviews. All interviewees were happy to participate in the interviews and were open to sensitive questions.

Number of interviews conducted:

Questionnaire 2 (farmers): 8
Questionnaire 3 (administrators): 11
Questionnaire 4 (stakeholders): 10

3 Perception of soil degradation in the case study area

3.1 Soil degradation problems

In the upper part of Moravia river basin 53 % (71,010 ha) of the total area is used for agriculture, of which 50,170 ha is arable land, 20,540 ha is grassland, and orchards cover 297 ha. The main soil degradation problem (Table 4) in the case study area is soil erosion by water due to large plots predominantly used as arable land, the hilly landscape or steep slopes in the highlands; intensive farming practices, and frequent extreme hydrological events. Most of the soil lost by erosion comes from cropland. There are three kinds of erosion: Rain-splash erosion: occurs when raindrops fall on unprotected ground; sheet erosion: occurs when thin layers of the topsoil are removed by the force of the runoff water; and rill erosion: caused by runoff water when it creates small, linear depressions in the soil surface.

Tolerable values (T values) for water erosion in the case study area range from 1 to 4 - 10 t/ha. The value 1 is correlated with shallow soils and soils with restrictive layers within particular depths. The value 4 represents moderately depth of soils (30-60 cm) and value 10 is for deep soils (above 60 cm).

As the draining system is poorly maintained, hydrological events cannot be sufficiently controlled.

Soil compaction occurs due to the intensive conventional farming on arable land (using heavy machinery) especially in the lower part of the case study area (around Brno City). (farm No. 7 and 8)

A decline in soil organic matter results from the constant soil erosion process. Main causes of decline in organic matter are conventional farming practices without applying manure and other organic matter. It is also linked with the decreasing water retention capacity of soils which in turn is caused by compaction and land conversion. Decline in organic matter causes a decrease of natural crop productivity of soil and decreases yield.

Table 4: Estimation of the severity of soil degradation problems on various farms

	Severity on the farms							
Soil degradation problem	farm 1	farm 2	farm 3	farm 4	farm 5	farm 6	farm 7	farm 8
Soil erosion (water)	3	3	2	3	3	2	4	4
Soil erosion (wind)	0	0	0	0	0	0	0	0
Decline in organic matter	1	1	1	1	2	3	3	3
Carbon balance	1	1	1	1	2	3	3	3
Diffuse contamination	1	1	0	1	1	1	3	3
Compaction	3	1	0	0	0	0	3	3
Acidification	2	1	0	2	2	1	2	2
Retention capacity	3	1	1	1	1	1	4	4
Off-site damages	2	1	1	1	2	1	4	4

Source: own assessment, interviews

Note: The numbers indicate the *severity of the soil degradation problems* for the farms, examined in questionnaire 2 with the level being 5 = severe to 0 = no problem. Ratings have been made by interviewees of the different farms.

Farmers' perception of the severity of soil degradation problems in their area is presented in Table 5. There was no difference between the opinion of farmers on the severity of soil degradation on the farm and off-farm in the surrounding area. A possible reason is the rather high acreage of the farms.

Farmers in the upper part of the case study area perceived a moderate risk of soil erosion by water (ranking 2-3). The ranking (3-4) of 3 farmers from the lower part of the study area represents the moderate to severe water erosion. The results confirm that the most important problem in the case study area is soil erosion caused by water.

Soil erosion caused by wind is not a problem in this area due to climatic conditions and land use, despite unfavourable soil conditions.

Farmers in the upper part of the case study area (farms 2-4) and farm No. 1 from the lower part of the case study area perceived a low decline of organic matter because there is a high production of available farmyard manure and farmers add organic matter back to the soil. The farmers on farms 5-8 estimated a moderate (ranking from 2 to 3) decline of organic matter. Their perception is influenced by the fact that they have a low production of manure (farm 4-6) and conventional arable farming (just cereals, maize and rapeseed production, especially on farm 7-8). The same evaluation applies to the problem of carbon balance.

Regarding diffuse soil contamination there is no problem on the farms 1-6 due to good management of fertiliser and special management in protected zones of water resources. A moderate contamination was identified by farmers in the lower part of the case study area that have conventional intensive arable farming (mostly cereals, corn and rape seed production).

Soil compaction is a moderate problem on farms 1, 7 and 8 with soils susceptible to compaction due to intensive (heavy machinery) conventional arable farming. This is not a problem on farms with light soil condition with a low content of clay particles in topsoil and subsoil.

Salinisation is not a problem in the case study area.

According to the farmers' perceptions, acidification is only a slight problem. Farmers believe that it is necessary to apply lime, but their economic situation does not allow them to buy lime or fertilisers with lime content.

Decreasing retention capacity of soils with consequences in on-site damages is most visible on the farms 7-8 with a high rate of soil erosion and compaction. The soil degradation on these farms is caused by intensive conventional growing of row crops (e.g. cereals such as maize and sunflower) without conservation measures and appropriate crop rotation.

Soil degradation is less severe on the farms 1-6 because these farmers had changed their land management practices in order to reduce soil degradation as recommended by the Water Rivers Authority of Moravia river basin.

The opinions of farmers on soil degradation trends differ from expert opinions in the case study area. Experts' assessments concerning soil degradation problems and damages are more critical. Water erosion, soil compaction and decline in organic matter are the results of inappropriate farming practices and lead to the degradation of the soil structure and cause severe damages both on- and off-site. On-site damages have accelerated due to the severe impact of soil erosion on complex soil properties with negative consequences on soil productivity. Soil erosion removes topsoil layers and during ploughing and tillage operations the topsoil is mixed with subsoil.

The subsoil usually has less desirable physical properties because it contains more coarse and clay material and has a poorer structure. Degradation of the surface structure is a second factor induced by erosion. This less desirable structure associated with soil compaction creates a greater bulk density that restricts seedling emergence and root penetration. A third factor is the loss of nutrients. Nutrients such as nitrogen, phosphorus,

and potassium can be solubilised in surface runoff or attached to soil particles that are removed during erosion. The results of soil degradation mentioned above are often characterised as “pseudo-drought”, a consequence of the loss of moisture and water-holding capacity.

Nutrients attached to sediments are lost during the erosion process in proportion to their concentration in the sediment at the point of detachment. The loss of these nutrients is associated with the removal of fine, inorganic and organic, colloidal material where the nutrients are adsorbed. With a reduction of the soil clay colloidal content over time, the productive capacity of the soil is reduced.

Dissolved nutrients are also lost in the run-off and deposited with sediments in various water reservoirs in the case study area. For example, in the Brno dam the amount of deposits containing sediments with a high content of nutrients, pesticides mixed with sediments from municipal waste is 3.8 mil m^3. From an environmental point of view this sediment is classified as a dangerous toxic material. This sediment material is an important source of the eutrophication of water with a great negative effect on water quality, aquatic life and recreational conditions.

Soil compaction as a form of physical degradation results in a reduction of biological activity, porosity and permeability. Further, the hardness is increased and the soil structure is partly destroyed. Compaction can reduce water infiltration capacity and increase the erosion risk by accelerating run-off. The compaction process can be caused by the wheels of the farm tractors and field equipment because these have become larger and heavier. Soil compaction can be associated with a majority of field operations that are often performed when soils are eroded and hence they are more susceptible to compaction. Heavy equipment and tillage implements can cause damage to the soil structure.

3.2 Trends in soil degradation and consequences

The perceived trends in soil degradation over the last ten years in the case study area are presented in Table 6. Over the last ten years, the general perception among farmers is that the soil degradation problems have shown a slight to moderate increase (except water erosion on farm 3 and retention capacity and off-site damages on farms 7 and 8), i.e. that soil degradation has become worse.

The best situation is found on the farms which have had technical assistance and support from the Water Rivers Authority. Soil degradation problems were mitigated (due to the high activity of Brno Agency of Water Rivers Authority) over the last ten years especially in the upper part of the case study area (part of the area is designated as drinking water protection zone, Vír Reservoir Dam). The application of conservation (mostly soil erosion control) measures decreases the soil degradation. The main reasons for the more favourable situation are: conversion of arable land to grassland, the use of intercrops and undersown crops, and suitable agricultural techniques causing less soil degradation. The situation on the lower part of the case study area is rather different. Soil degradation increase is due to accelerated soil erosion and the lack of willingness of land users to apply soil conservation measures during the last ten years, associated with weak legislation and lack of economic motivation. Further, land users are aware of degradation problems in the case study area to some extent but there is a lack of information and educational programs on the environmental problems and the consequences of soil degradation processes.

Farmers perceived a higher rate of increase of soil degradation due to soil erosion, decline in organic matter, carbon balance, reduced water retention capacity, and off-site damages

Nevertheless, the importance of profit still outweighs the need for soil conservation in the decisions of some farmers. One farmer explained that they are still prepared to grow corn, and other crops with high net margins (e.g. rapeseed and poppy seed), naturally with high risks of soil erosion, on land prone to soil degradation.

Table 5: Trends in soil degradation on various farms over the last ten years

	Trend							
Soil degradation problem	farm 1	farm 2	farm 3	farm 4	farm 5	farm 6	farm 7	farm 8
Soil erosion (water)	2	3	4	1	3	2	3	3
Soil erosion (wind)	-	-	-	-	-	-	-	-
Decline in organic matter	1	1	1	1	2	3	3	3
Carbon balance	1	1	1	1	2	3	3	3
Diffuse contamination	1	1	-	1	1	1	3	3
Compaction	3	1	-	-	-	-	3	3
Acidification	2	1	-	2	2	1	2	2
Retention capacity	3	1	1	1	1	1	3	4
Off-site damages	2	1	1	1	2	1	4	4

Source: own survey
Note: The numbers indicate the *trend of the soil degradation problems* for the farms, with the level being 5 = large change to 1 = small change. All ratings are positive indicating that soil degradation is perceived to have become more severe. Ratings have been made by interviewees of the different farms (Questionnaire 2).

The negative trend in soil degradation especially due to water erosion continued, despite significant soil degradation appeared. The reason is that current and recent effects of erosion on productivity have been masked by improved and increased fertilization, improved cultivars, selective pesticides, technology and management. However, it is evident that this compensatory process cannot be maintained indefinitely.

4 Farming practices and soil conservation measures

4.1 Farming practices and their effects on soil

4.1.1 Farming practices that cause soil degradation

In the case study there are two farm types: Mixed farms including arable and livestock with a conventional production orientation with ploughing, and arable farms with a conventional production orientation with ploughing. The key livestock is bovine (race: Holstein-Friesian) grazing through summer months (May to October) with average livestock stocking rates of 0.5-1.5 LSU per hectare.

Table 6 shows an overview of the typical cropping systems and their characteristics in the case study area. The application of the different farming practices has different effects on soil.

Conventional farming in areas within the protection zone of drinking water resources in the Vir dam catchments mostly represents low inputs of nutrients by fertilisers and inputs of chemical pesticides. In contrast, conventional farming in other parts of the case study area has mostly high inputs of nutrients and inputs of chemical pesticides. Negative effects of conventional tillage in both parts of the case study are increased water erosion from bare soil surfaces, as well as crusting and compaction of the topsoil and subsoil. Soil erosion caused by water destructs the soil's structure, reduces crop productivity due to deterioration in soil

physical and chemical properties such as infiltration rate, water-holding capacity, loss of nutrients needed for crop production, and loss of soil carbon. The effects of soil loss depend upon the type and depth of the topsoil. Water erosion occurs on fields with row crops (maize, sunflower), especially during the rainfall period from April to October.

Decline in organic matter mainly depends on the type of farm and cultivation. For example, there is no problem in case of mixed farms with animal production. The problem of decline of organic matter is on arable farms mostly cropping winter wheat, barley and maize. These farms very often use so-called mono-cropping farming systems without an appropriate crop rotation. The soils in mono-cropping farming often exhibit a degraded structure, with soil crusting, and causing a severe rate of erosion a decrease of water retention capacity.

Soil compaction is a form of physical and biological degradation resulting in a reduction of porosity, permeability, water infiltration capacity and biological activity, increased bulk density, accelerated runoff and erosion, resulted in damage on soil structure. The compaction process is initiated by the wheels of heavy machinery. On arable land with conventional ploughing both topsoil and subsoil compaction occurred. When topsoil and subsoil are damaged annually, compaction becomes cumulative and a compacted layer is created. Reduced infiltration capacity results in surface run-off, eventually leading to flooding, erosion and transport of nutrients and agrochemicals, i.e. off-site damages to the water network, lakes and other water reservoirs.

There are several causes, natural and human-induced, that compact a soil. Compaction results from the used machinery, the applied tillage system or from raindrops. The raindrop impact is a natural cause of compaction, leading to a soil crust that may decrease retention capacity and seedling emergence. Tillage operations such as ploughing repeatedly at the same depth will cause serious compacted layers just below the depth of tillage in some soils. This tillage compaction has a negative effect on crop production, and it is necessary to apply special subsoil disturbance operations. Wheel traffic is the major cause of soil compaction. With increasing farm size, the size and weight of tractors has also increased. Another important cause of compaction is the application of mono crop rotation which limited different rooting systems and their soil protecting effects by breaking compaction layer.

As described above, soil compaction mainly results from the use of heavy machinery and tillage type, and therefore it is necessary to adapt wheel sizes and pressure to soil conditions. In addition, the cultivation of soil with no tillage or reduced tillage can also prevent or reduce soil compaction.

The drainage system has finished its life cycle (approximately 30 years) and such a system with decreasing effectiveness becomes a serious problem.

Table 6: Typical cropping systems, their characteristics and the estimation of impacts of soil degradation problems in the case study Svratka River Basin

Crop	Winter wheat	Winter rye - Grain	Barley, spring - Grain	Potato - Root	Rape - Grain	Maize, Fodder - Fodder
Production orientation	conventional	conventional	conventional	conventional	conventional	conventional
Farm type	arable farm	arable farm	arable farm	arable farm	arable farm	arable farm
Tillage type	Ploughing	ploughing	ploughing	ploughing	ploughing	ploughing
Irrigation type	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation
Soil quality class[a]	2	1	2	1	1	2
Soil degradation problem		vulnerability				
soil erosion water		low	medium	high	high	
decline in organic matter		medium	medium	high	high	high
compaction		low	medium	medium	medium	medium
decrease of water-retention capacity		low	medium	medium	medium	high
off-site damages		low vulnerability	medium vulnerability	high vulnerability	high vulnerability	high vulnerability

Source: own assessment, interviews

a: There are two soil quality classes in the case study: class 1 means sandy and loam soils, dystric cambisol (poor quality); class 2 means loam soils, eutric cambisol (good quality, i.e. high fertility and good nutrient matter)

Note: in addition to these results further statements to typical cropping systems were given in the framework of Questionnaire 2

4.1.2 Farming practices that prevent soil degradation

To avoid these negative effects of the conventional tillage on soils there have been efforts to apply the whole system of soil conservation measures in the case study area. This system of soil protection includes organisational, agro-technical, biotechnical and technical soil conservation measures. The main conservation measure, from conservation point of view, is the conversion of arable land to grassland and it was undertaken in the upper part of the case study area during the last ten years. In the area of the protected zone of drinking water dam, this conversion represents the application of grassed waterways in areas of concentrated runoff. Conversion to permanent grassland in the case study area was targeted at shallow soils with a high content of coarse material, on plots on steep slopes, and in areas with a high level of water table due to a low efficiency of drainage system. Important are the buffer strips along the banks of water network.

Some farmers (on 2 farms from 8) implemented reduced tillage and intercrops with direct drilling seed of corn into stubble mulching and use the conservation crop rotation without row crops (maize, sunflower) on selected plots.

4.2 Suitable soil conservation measures

Appropriate conservation measures are required to prevent and reduce soil degradation resulting from intensive agriculture. Table 7 and Table 8 show an overview of effects of soil conservation measures on soil degradation problems in the case study area independent of the type of crop.

Most of erosion-control practices either

- Require some additional inputs of capital and labour (e.g. seed material for intercrops or establishing and maintaining grassed waterway, infiltration grass buffer strips, terraces), or
- May reduce yields caused by competition of other crops (e.g. intercrops) or by reducing the area available for cropping (e.g. terraces).

The adoption of the most appropriate practices depends on the identification of “hot spots” plots and areas. In order to optimise the farming conservation system it is necessary to carry out analyses and evaluations of the erosion rate and the basic characteristics of runoff in given sub-catchments. Results should be attributed to the users’ block in the Land Parcel Identification System (LPIS). This type of analysis should cover the whole agricultural area of the Czech Republic. This system of evaluation provides information about erosion and runoff risks plots (or its parts) and serves to land users for decision making regarding soil conservation measures.

Intercrops and undersown crops

Intercropping is meant to reduce erosion and cover soil surface during periods of intense rainfall, contributing to sustainable production of maize in the long term. Intercrops (cover crops) temporarily protect the soil until the main crop is planted. Intercrops also add organic matter, hold nitrogen, and reduce weed growth. Undersown crop means that while the main crop (e.g. wheat) is sown, a second crop is also sown (e.g. grass, lucerne). The second crop grows slower and after the main crop is harvested the undersown crop already has the capacity to prevent soil erosion and nutrient loss. The measure increases the biodiversity of the landscape.

Reduced tillage or conservation tillage

Reduced tillage or conservation tillage is a practice of minimising soil cultivation by leaving crop residues or stubbles on the soil. Reduced tillage means reducing the number of tillage passes.

Reducing tillage is important from the viewpoint of environmental farming for several reasons. Leaving crop residues on the field helps to prevent soil erosion by water, thus conserving valuable topsoil. Maintaining surface residues also protects the soil from degradation by weathering and encourages worm and microbial activity. As earthworms are not being routinely disturbed by deep tillage, their numbers increase leading to a better soil aeration and improved soil fertility. Microbial activity in soil also increases. Farming with conservation practices results in less soil compaction and disturbance, thus promoting water availability to plant roots. The soil structure is improved because heavy machinery (which causes soil compaction) is not used. Another important environmental effect of reduced tillage is the reduction of use of fuels.

Contour tillage

Contour farming runs tillage operations parallel to the contours of the slope. Crop rows form many small accumulation spaces that catch water and reduce soil loss up to some 30 % compared to farming up and down a slope. The measure is regarded as medium cost-effective measure.

Restriction of row crops on steep slopes

The most important measure is a restriction of wide row crops on steep slopes and including changing crops. There is a special technical rule in the Czech National Conservation Handbook: no wide row crops without conservation operations on any slope above 7 %. This measure was identified as the second most cost-effective measure in the case study area.

Grass infiltration strips

Grass strips are barriers for reduction of soil erosion. They increase retention capacity, decrease the water runoff and part of the sediment is deposited.

Grassed waterways

Grassed waterways to control runoff are broad base, shallow-shaped channels designed to lead surface water across cropland without causing soil erosion. The grass cover in the waterway slows the water flow and protects the channel surface. Waterways are often designed in natural geomorphological depressions.

For land users to adopt better soil-conserving practices it is essential that they are aware that soil erosion is a problem, and that they themselves are involved in the development and testing of production practices that reduce erosion. The interviews showed that most of the interviewed farmers are aware of soil degradation problems and that they are willing to undertake action to mitigate the problems.

Implementation of soil conservation measures depends on the ability and the willingness of land users to apply them. The farmers who are not able to apply soil conservation measures should be supported by education and training.

Unfortunately, the system of reduced tillage and conservation crop rotation are applied only in parts of the case study area in Vir Dam catchments area. The main conservation measure with a high efficiency against erosion and soil compaction which should be implemented in the future is special conservation crop rotation without wide row crops on selected plots (mostly with slope above 7 %) with gassed waterway and infiltration grassed buffer strips or broad base channels.

Table 7: Effects of cropping/tillage soil conservation measures on soil degradation problems

	Soil degradation problem									
Measures	soil erosion water	soil erosion wind	decline in organic matter	negative carbon balance	diffuse contami-nation	compaction	salinisation	acidification	decrease of water reten-tion capacity	Off-site damage
intercrops	1	1	1	1	1	1				1
undersown crops	1	1	1	1	1	1				1
grass strips	1	1	1	1	1	1				1
reduced tillage	2	2	1	1		ne				1
contour tillage	1	0	0	0					1	1
restriction of row crops on steep slopes	2	1	2	2		1				2
wheel sizes and pressure/restricting excessive heavy machinery use	1					2				
restrictions on the max. amount of (liquid) manure application					1					1
restrictions of manure application to a certain time period					1					1
restrictions on the max. amount of N-fertilisation					2					2
restrictions on the max. amount of P-fertilisation					1					2

Source: own assessment, interviews

Note: The numbers indicate *the general effects of soil conservation measures on soil threats in the case study*, examined in Questionnaire 1 with the following units: 2 = farming practice highly mitigates the threat, 1 = farming practice mitigates the threat, 0 = farming practice has no effect on threat, ne = depending on other variables the farming practice mitigates or increases the threat. The grey marked cells are not relevant because this measure has no relationship to the threat.

Table 8: Effects of long term soil conservation measures on soil degradation problems

	Soil degradation problem									
Measures	soil erosion water	soil erosion wind	decline in organic matter	negative carbon balance	diffuse contami-nation	compaction	salinisation	acidification	decrease of water reten-tion capacity	Off-site damage
change of crop rotation	1	1	1	1	1	1			1	1
liming			1	1		1			1	1
change of field patterns and sizes (please use the comment box to specify)	1	1	1	1	1					1
retention ponds	1	0	0	0	0	0				
subsoiling						2				
adjusting duration and season of grazing animals	1				1	1				1

Source: own assessment, interviews

Note: The numbers indicate the general effects of soil conservation measures on soil threats in the case study, examined in Questionnaire 1 with the following units: 2 = farming practice highly mitigates the threat, 1 = farming practice mitigates the threat, 0 = farming practice has no effect on threat. The grey marked cells are not relevant because this measure has no relationship to the threat.

5 Evaluation of soil conservation measures

5.1 Cropping/tillage measures

In the case study Svratka the following cropping/tillage measures are applied by farmers (Table 7):

- Intercrops
- Undersown crops
- No tillage/ direct drilling
- Reduced tillage
- Contour tillage
- Restriction of row crops on steep slopes
- Wheel sizes and pressure / restricting excessive heavy machinery use
- Restrictions on the max. amount of (liquid) manure application
- Restrictions of manure application to a certain time period
- Restrictions on the max. amount of N- fertilisation
- Restrictions on the max. amount of P-fertilisation

Note that the assessment of the cost-effectiveness of selected measures was undertaken mainly regarding soil erosion.

Intercrops

Intercrops (e.g. mustard, clover, grass [*Iolium*]) means the growing of two or more crops on the same field with the planting of the second crop after the first one has completed its development, are already widely used as soil conservation measure in the case study area especially in organic farming. In intercropping, there is often one main crop and one or more added crops, with the main crop being the one of primary importance because of economic or food production reasons.

Economic costs of intercrops

- Because of the necessary purchase of seeds the costs of adopting this measure are rather high. Further, there are additional costs for seedbed preparation associated with additional working costs and labour costs. Intercrops are less cultivated for economic reasons but rather for soil conservation..
- The government supported intercrops in 2004-06 (€ 144/ha) but reduced the payment from 2007 to € 104. It is questionable whether farmers will join in sufficient numbers the scheme again. The scheme was very popular in years 2004-06. The payment is granted to area which exceeds some minimal area.

Technical restraints

- The use of intercrops is limited by certain types of crop rotations and climatic conditions in region.

Environmental effectiveness

- Experts reported that the cover crops are effective in erosion prevention. Some farmers reported that for that reason they would continue with the measure despite of payment decrease/cease of support.
- When there is excessive amount of organic matter and crops survive winter fully herbicide is used to destroy it.
- The effectiveness of this measure as a prevention of nutrients loss is linked to sufficient biomass produced.

This means that the economic efficiency of intercrops is relatively low when compared to other soil conservation measures. Sometimes intercrops such as clover are used for fodder. Intercrops are important for soil conservation. As intercrops ensure covering the soil by plants, water erosion and soil run-off is generally reduced and soil fertility increases. Further, the cultivation of intercrops has a positive effect on biodiversity, provides for preservation of nutrients and accumulates soil with organic matter. Another positive effect in using intercrops is the control of spreading of weeds, e.g. bromes, and pests like mice and snails. The main factor influencing the adoption of this measure is that intercropping is associated with high costs for seeds and high working costs.

Cover crops belong to the medium cost-effective measure and undersown crop represents the second most cost-effective measure.

Reduced tillage and no-tillage

This practice is used in case of maize and sunflower. Reduced and no tillage is not regarded as cost-effective measure in the case study area. No tillage is regarded as a medium cost-effective measure. Reduced and no-tillage agriculture operation has been a preventive system to control soil erosion. The best management technology includes the modification of suitable machinery, amending the soils through chemistry and microbiology with a positive effect on the complex of physical properties of the soil and increase water use efficiency.

A fundamental goal of reduced tillage in the upper part of Svratka river basin is to avoid bare soil between crop plantings. This not only protects soil, but produces biomass that protects and enhances soil quality. Numerous on and off side benefits accrue from this approach as well, such as improved erosion stability, reduced compaction and enhanced retention capacity for flood prevention.

Farmers cultivate land by preparing a seedbed, controlling weeds and conserving soil moisture. Unfortunately, cultivation also exposes bare soil to the direct effects of rainfall causing erosion, degradation structure and surface crust decreasing infiltration rate and increase soil erosion and runoff.

Reduced cultivation involves grazing of crop stubble and weed growth after harvest followed by seedbed preparation, which includes fewer cultivations than in a conventional system. There may be only one cultivation followed by an application of a contact herbicide before or after sowing. Reduced tillage decreases some types of soil degradation with one of the reason being that the soil is covered by crop residuals preventing the negative effects of rain.

Direct drilling (no tillage) involves no cultivation of the soil meaning to sow directly into undisturbed soil. Stubble from the previous crop and subsequent weed growth are removed by grazing during the fallow and the stubble remaining is usually burnt after the seasonal break of rain. The fallow is sprayed with a contact herbicide prior to sowing. This practice is usually adopted in the upper part of the case study area in the protected zone of drinking water resource for wide row crops especially maize.

The conversion of arable land to grassland, grassed waterways, grassed infiltration buffer strips, reduced tillage, direct drilling into stubble mulching and conservation crop rotation without row crops on severely eroded plots can be applied almost immediately, but the application depends on the ability and willingness of the farmer. This is only a first but a very important step. For the optimal function of soil conservation systems it is necessary to add biotechnical and technical measures.

Economic costs

- Reduced tillage/direct sowing is associated with higher investments needs and not all farmers can afford it. Some of the hire specialised firms for sowing.
- There is no specific support for such practices.

Technical restraints

- Specific machinery is required.

Environmental effectiveness

- Reducing tillage is important from the viewpoint of environmental farming for several reasons. Leaving crop residues on the field helps to prevent soil erosion by water, thus conserving valuable topsoil.
- Maintaining surface residues also protects the soil from degradation by weathering and encourages worm and microbial actions. As earthworms are not being routinely disturbed by deep tillage, their numbers increase leading to a better soil aeration and improved soil fertility.
- Microbial activity in soil also increases.
- Farming with conservation practices results in less soil compaction and disturbance, thus promoting water availability to plant roots.
- The soil structure is improved because heavy machinery (which causes soil compaction) is not used.
- Another important environmental effect of reduced tillage is the reduction in use of fuels.

Contour tillage

Contour tillage is used in the case study catchments and can be used to retain water on the contour, so preventing erosion and surface runoff through the increase of the infiltration rate.

Economic costs of contour tillage

- Because or orientation of the fields towards slope could be unfavourable there could slight increase in cost of tillage (fuel, labour).

Technical restraints

- Sometime the shape/size and slope of the field makes the contour tillage not feasible.

Environmental effectiveness

- The contour tillage slows down water run off.

Restriction of row crops on steep slopes

The most important measure is Special Conservation Crop Rotation with a restriction of wide row crops on steep slopes and including changing crops. A rotation includes mostly grasses, legumes, or small grains which reduce erosion compared to continuous wide row crops (maize, sunflower) that leave soil bare during growing season.

Economic costs of excluding of row crops from rotation

- Exclusion of row crops could force some farmers to exclude these (usually cash crops) from crop rotation or to shift them to less favourable conditions which usually represent loss of income.

Technical restraints

- There is not significant technical restrain.

Environmental effectiveness

- It helps in prevention of soil erosion by water up to some degree of slope.

Wheel sizes and pressure/ restricting excessive heavy machinery use

The use of wheels with lower pressure is rare in the case study area. The main reason is the high cost of the additional wheels. This measure is not regarded as a cost-effective.

Economic costs of reduced pressure of machinery

- Farmers indicated that especially special tires/additional ones represent significant investment and they are not ready to pay the cost.

Technical restraints

- Adjustment machinery is usually required (e.g. additional wheels).

Environmental effectiveness

- Reduced pressure prevents soil compaction in conditions where normal wheels could cause it. In many cases this could be achieved by proper timing of the tillage.

Restrictions on the maximum amount of (liquid) manure application

Restrictions on the amount and timing of use of liquid manure on slopes and especially those slopes heading towards water bodies are part of the Action Plans in Nitrate Vulnerable Zones. The upper part of the case study area is designated as a NVZ. Usually there is no difficulty to comply with the restrictions of the total amount of manure since the livestock density in the Czech Republic is generally low.

Economic costs of restriction of manure application

- Farms with animal production have to spread the manure and the season is limited and in addition some areas close to waters are excluded from manure (especially liquid). Therefore the investment to manure storage facility is needed.
- There is support of the investment under Rural Development Program for this purpose but farmers have to share the costs and it represent significant financial burden.

Technical restraints

- Because the requirement for storage facilities was increased to 6 months for all kinds of manure in 2008, about 70 % of farmers have to construct new/increase capacity of storage facility.

Environmental effectiveness

- The measure is targeted at water protection mainly and is not so important for soil conservation.

Restriction of manure application to a certain time period

The restriction is also part of the action plans in NVZs and relates to the particular season when plants cannot utilise the nutrients released by manure (e.g. late autumn).

Economic costs of restriction of manure application

- Farms with animal production have to spread the manure and the season is limited and in addition some areas close to waters are excluded from manure (especially liquid). Therefore the investment to manure storage facility is needed.
- There is support of the investment under Rural Development Program for this purpose but farmers have to share the costs and it represent significant financial burden.

Technical restraints

- Because the requirement for storage facilities was increased to 6 months for all kinds of manure in 2008, about 70 % of farmers have to construct new/increase capacity of storage facility.

Environmental effectiveness

- The measure is targeted at water protection mainly and is not so important for soil conservation.

Restrictions on the maximum amount of N- fertilisation

The total amount of manure applied should not exceed the equivalent of 170 kg N/ha. This rule is part of the Action Plan in the NVZ. The requirement is not demanding for farmers because the total amount of manure produced on farms is usually small. Livestock density in the Czech Republic is generally low. The same applies to phosphorus

Restrictions on the maximum amount of P- fertilisation

This rule is not applied regularly in the case study area. Protection measures such as restrictions on the maximum amount of manure, N and P fertilisation were applied in the case study area according to a special project based on detailed inputs of data using parametric methods.

5.2 Long-term measures

In the case study area Svratka the following long-term measures are applied by farmers (Table 8):

- conversion of arable land to grassland (whole fields or waterways),
- creation of field banks and field roads when reshaping the field size and patterns,
- grass infiltration and buffer strips.

Conversion of arable land to grassland

- As a result of support from the Water Authority or the government, farmers converted the most sensitive fields on slopes to grassland. Grass with its root system slows down the water runoff and allows for infiltration and belongs to the cost-effective measures.

Economic costs of conversion of arable land to grassland

- There are significant costs associated with investment to grassland introduction and to loss of cash crops (reduced arable area). Because of the low animal density the additional grass usually has not high economic value.
- Farmers are not willing to conversion of arable land except for fields with extreme slopes (usually done in 90s).
- There is support of conversion of arable land under Rural Development Plan (€ 270-374/ha, i.e. on slopes or with regional seed mixture). The uptake is limited.

Technical restraints

- There are not significant technical restraints.

Environmental effectiveness

- The measure is targeted at soil and water protection. Grass effectively reduces water run off, contributes to retention capacity and therefore is very effective measure for erosion prevention.

Change of field pattern and sizes

The main advantage of landscape features created for erosion control such as field banks and field roads is that they are permanent and farmers are not allowed to destroy them. If designed well these features influence significantly the risk of soil erosion by interrupting slopes and allowing for infiltration. The change of field size and field patterns has the same effect. Both landscape features and field patterns are created as a part of a land consolidation process and therefore are quite cost-effective but quite rare in the case study area.

Economic costs of conversion of change of field patterns and sizes

- Because of the ownership structure farmers usually do not afford to do this measure except as a part of land consolidation process.
- There are significant costs associated with designation of the fields and creation landscape features associated with change of field size/shape (e.g. field roads, ditches).

Technical restraints

- There are not significant technical restraints and this is usually done by companies hired by state when part of land consolidation process.

Environmental effectiveness

- The measure is very effective when done as a part of project designed by an expert.

Grass infiltration and buffer strips

This measure was identified as the most cost-effective tool in the case study area. Buffer strips are wide strips of vegetation consisting of grass, clover or alfalfa surrounding the disturbed site of row crops. Grass infiltration and buffer strips provide infiltration, intercept sediment and other pollutants, and reduce stormwater flow and its velocity and thus reduce erosion. Grass buffer infiltration strips should be designed to avoid soil erosion and increase water retention capacity of landscape. The minimum width designed in the case study area is 30 m. The other functions are to maintain moisture soil conditions immediately after seeding and/or sod fixing throughout the vegetation establishment period. Filter and buffer strips are able to remove some sediments and pollutants from water runoff if correctly designed and constructed. Grass strips allow particles to settle and filter out from water runoff. Generally, a maintained grass filter strip is used to treat very shallow or sheet flow. Filter strips have high efficiency when used in combination with other best management practises such as direct drilling seed of wide row crops (maize, sunflower) into stubble mulching. Filter and buffer strips are often used as an additional element with other water management practices to reduce runoff from arable land such as broad base terraces. Filter and buffer grass strips may also be used as a temporary erosion control line element before building a broad base channel and terraces during land consolidation process.

Economic costs of grassland strips

- There is cost associated with loss of income from arable crops, investment to grassland introduction and with higher machinery costs (fields are broken to smaller plots).

Technical restraints

- There are not significant technical restraints. Operation of smaller fields created by introduction of grassland strips is not so smooth (longer and narrower fields).

Environmental effectiveness

- The measure is effective as erosion prevention measure and in increasing of water retention capacity of soils.
- Filter strips are able to remove nutrients, and suspended solids, as long as the flow is not high (low to moderate). Infiltration and biological uptake also occur as runoff flows through the filter strip.

The long term measures applied in the case study area are soil conservation practices that reduce soil erosion and thus produce a long term benefit for conservation. All mentioned conservation measures have a long term effect towards increasing infiltration rates and retention capacity (improving soil water storage) and in turn increasing soil productivity. The increase of soil organic matter and structure stability in the topsoil can restore infiltration and retention capacity. However, many research results emphasise that soil conservation is a long term process, requiring a period of several years to show significant impact.

5.3 Conclusion

As mentioned above, the best situation is on the farms where soil degradation problems were already improved (mostly due to a high activity of Brno Agency of Water Rivers Authority) during the last ten years and especially in the upper part of the case study area (a part of the area is designated as drinking water protected zone: Vír Reservoir Dam). This improvement is mainly due to farmers adopting a system of agro-technical and organisational measures such as conversion of arable land to grassland and growing of intercrops and undersown crops and suitable agricultural techniques causing less soil degradation.

Nevertheless, when introducing a soil erosion control in a certain watershed, agro-technical soil management and organisational practices themselves are mostly unable to restrict a surface runoff substantially. For that reason it is necessary to apply a whole system of soil conservation measures. In places with long slopes technical and biotechnical soil erosion control practices (primarily of linear character) are necessary. These technical measures are: broad base channels, hedges, grassed infiltration belts, ridges with green growing, wind breaks, etc. These biotechnical measures together with the implementation of adjusted and grassed courses of concentrated surface runoff (grassed waterways) create an appropriate network of new hydrolines in the watershed. Biotechnical line elements of soil erosion control serve as permanent barriers or obstacles for water runoff and are designed in order to determine, by their location, the ways of land management.

Some technical and biotechnical measures could be suitable regarding their technical feasibility, economic efficiency and environmental effectiveness. The various types of channels, terraces, new field road structures and retention ponds and polders can be applied taking into account the requirements for ecological stability.

The spatially and functionally limited soil-conservation system of line and aerial biotechnical and technical elements in a region offers spaces and lines in which it would be possible to locate territorial systems of ecological stability under certain conditions. I.e. area and line elements of soil erosion control practices should be polyfunctional and territorial systems of ecological stability as a spatial expression of a certain functional interest.

Soil conservation practices, both aerial and linear ones, connected with territorial systems of ecological stability can be characterized as desirable anthropogenic landscape-forming elements and small-sized territories. These would form the appearance of the landscape and significantly enhance natural processes in the region. They create suitable biological conditions in spite of the fact that they mostly do not meet qualitative and dimensional characteristics of biocentres and biocorridors.

Biotechnical and technical soil conservation measures cannot be applied without respecting property rights. Therefore it was found suitable to design the system of the soil and water conservation in the process of land consolidation in the Czech Republic.

Recently, the process of complex land consolidation in the Czech Republic has provided a unique opportunity for improving the quality of the environment and sustainability of crop production through better soil and water conservation. The current process of the land consolidation consists of:

- the rearrangement of plots within a given territory, aimed at establishing the integrated land-use economic units, consistent with the needs of individual land owners and land users.

- the public interests e.g. environmental protection (soil, water and biodiversity) have to be taken into account and respective measures implemented (e.g. creation of permanent soil protection measures like field banks).

6 Soil related actors

6.1 Actors in the farming practices arena

The visited farms are typical both for the case study area and the Czech Republic. Soils and climatic conditions also well represent the situation found across the country. Advisors operating in the case study area do not provide advice on soil conservation and in general a large proportion of farmers do not use their services.

6.1.1 Description of characteristics and attitudes

In the case study region Svratka there are different actors in the farming practices arena. Table 9 shows the characteristics of the interviewed farmers and their farm. In addition to the characteristics in Table 9, it should be noted that all eight farms have land under lease-hold.

Table 9: Characteristics of the interviewed farmers

Affiliation/position of the interviewee	Type of the farm	Farm size [ha]	Typical crops	Typical livestock
Cooperative farm, manager of the farm	arable, livestock, conventional	1,242	Winter wheat, barley, rapeseed, poppy seed, maize fodder crops grassland	Bovine, pigs
Agricultural Joint-stock-company, manager of the farm	arable, livestock, conventional	1,385	Grassland, Clover Winter wheat, barley rape, ray, maize fodder crops	bovine
Agricultural Joint-stock-company, manager of the farm	arable, livestock, conventional	712	Grassland, Clover Winter wheat, barley, rapeseed, rye, maize fodder crops	bovine
Cooperative farm, manager of the farm	arable, livestock, conventional	1,202	Grassland, Clover Winter wheat, barley, rapeseed, poppy seed, maize, rye fodder crops	bovine
Cooperative farm, manager of the farm	arable, livestock, conventional	860	Grassland, Clover, Lolium Winter wheat, barley, rapeseed, rye, maize, fodder crops	bovine
Agricultural Joint-stock-company, manager and owner of the farm	arable, livestock, conventional	619	Grassland Winter wheat, barley, rapeseed, poppy-seed, maize fodder crops	bovine
Agricultural Joint-stock-company, manager of the farm	arable	292	Winter wheat, barley, rapeseed, poppy-seed, maize alfalfa	None
Agricultural Joint-stock-company, manager of the farm	arable, livestock, conventional	365	Winter wheat, barley, rapeseed, poppy-seed, maize fodder crops, alfalfa	None

Source: own presentation, data from interviews

6.1.2 Factors influencing adoption of soil conservation measures

The success of the system of soil conservation depends on suitable technical assistance and support from responsible state organisations (Ministry of Agriculture and Ministry of Environment), sufficient sources of information as well as the ability and willingness of land users to adopt soil conservation measures. Farmers learn about suitable farm practices by application and they get information from neighbours. In addition they attend courses, use

the internet and journals (but these are frequently in English and therefore not useful). Advisory services are not always available to farmers, because there are not enough advisors.

The farmers have no opportunity to engage in policy design or influence approaches to policy implementation. However, farmers are not generally keen to join the policy process but they want to be represented by farmers' organisations.

The main motivation for farmers to apply soil conservation measures is the economic motivation through financial subsidies (for example planting intercrops under agri-environmental schemes) along with penalties for farmers if they fail to comply with the rules of the funding program.

Studies or projects dealing with permanent changes in land use in order to increase soil erosion control cannot be implemented without solving property rights issues first. Integral parts of any project of soil erosion control (its basic network) are usually line elements for soil erosion control (broad base channels, soil erosion ridges, ditches, etc.), which run across individual owners' fields. Therefore it is necessary to identify every owner and discuss with him/her the project and relevant proposals.

The option is to apply the land consolidation process. Optimum spatial and functional delimitation of soil erosion control practices in the landscape is one of the basic steps in the plan of complex land consolidation, in addition to the implementation of a new network of field roads and landscape features enhancing ecological stability. Soil erosion control practices are included in the system of public facilities (as a part of the plan of poly-functional network) within the framework of the land consolidation process (where property relations are consistently solved). State land and partly owners' land is used for the creation of such line elements (state-owned land being used first).

Experiences with past and present agri-environment schemes show that farmers need assistance in case of demanding measures or when their decision is not easy because of potentially high opportunity costs. For example, the introduction of grassland strips across the slopes (erosion prevention measure) failed because farmers were not well informed about the measure and thus there was low uptake. In contrast, wildlife feeding strips are similarly demanding and not economically beneficial to farmers but this measure is very successful. The difference is that there is a hunter association which acts as a partner for farmers and persuades them to introduce feeding strips on arable land while there was no partner in case of grassland strips.

6.2 Actors in the policy design and implementation arena

This section investigates actors in the policy design and policy implementation arenas. There is not only one uniform network of actors as they vary (and overlap) according to the different types of policies. This means that the network of actors related to agri-environmental schemes (AES) differs from the network associated with land consolidation. Therefore the actors and relevant networks will be described in relation to the particular policy.

6.2.1 Governmental organisations

There are two key actors involved in policy design and implementation; the Ministry of Agriculture (MoA) and the Ministry of Environment (MoE). Both ministries are part of a governance structure which also has regional centres in the case study area.

Responsibility on soil protection is divided between MoA and MoE. Under the umbrella of both ministries there are a number of organisations supporting the policy process from design to evaluation. Structure and links of key organisations in soil protection are depicted in Annex 3.

Ministry of Environment (MoE). MoE policy for soil conservation is enforced by regional governments and municipalities with extended power. They receive methodological support from the regional offices of the Ministry. Under MoE the main partner for policy making and implementation is the Agency for Protection of Nature and Landscape (AOPK), also involved in soil protection. Under MoE there is a research institute dealing with water protection (Research Institute of Water Protection, VUV), which is also relevant for the EU Nitrate Directive jointly implemented by MoE and MoA. The institute plays key role in the NVZs designation.

MoE treats soil as a natural resource (in contrast to soil as a factor of production). Therefore it designs and implements regulatory policies (institutions) to protect soil and land from its loss (e.g. regulating construction on land) and to protect the soil quality (e.g. rules preventing soil degradation). MoE sets the rules for the collection of fees in case a construction is allowed on agricultural land. MoE also establishes provisions for the enforcement of soil quality protection such as penalties in case the soil is damaged. However, this provision is not commonly used.

The key institution enforcing regulatory policies under MoE is the Czech Inspection for Environment. Its responsibility covers all issues and categories of natural resources but soils (e.g. nature, air, water, waste). Therefore, if there is a case of soil degradation of exceptional degree and the Inspection finds the evidence, the case is treated according to the Law on Environment Protection No. 17/1992. However, this is not a particularly efficient approach. There it is regarded as an institutional gap that there is still no relevant unit within the organisation.

MoE plays a role in the following policy processes governed by MoA:

- Agri-environmental measures (key partner in policy design),
- GAECs (MoE is consulted),
- Protection of soils in framework of nitate vulenrable zones (NVZs) (key partner, which is consulted),
- Land consolidation (regional offices or municipality level offices are consulted on proposal on land consolidation).

MoE is responsible for the design and implementation of the Law on Soil Protection (334/1992) and related lower level legislation (directives and decrees). The policy is enforced by relevant offices in the regional governments and municipalities with extended responsibilities (municipality of class 3[6]). The level where the case is solved is decided on the basis of the size of land in question.

When there is application for change of agricultural land to construction site the case is resolved on following level:

Size of the land in question (ha)	Relevant level – office responsible for approval
Up to 1	Municipality (level 3) with extended responsibilities
1-10	Regional government
More than 10	MoE

Source: own presentation; data from survey

All mentioned regional levels of MoE administration also have the power to enforce legislation on the protection of soil quality and prevention of soil degradation. However, this potential is rarely used. The reason is the vague wording of the law (§ 3): “1) The land should be managed in a way that the soil is not contaminated and hence food chain and sources of drinking water (…) and land in surrounding is not damaged and also favourable physical, biological and chemical properties of the soil are not damaged (…)”. The wording does not

[6] The responsibilities and relevant decision-making power grow with size of municipality. Therefore these are limited in smallest municipalities, extended in larger and quite wide range of responsibilities in so called “recognised” (class 3) municipalities.

support the administration in cases where they need to prove that the land owner/operator failed to comply with the law, i.e. it is difficult to prove the land was not managed properly.

MoE started a new supporting measure for erosion prevention under Operational Program for Environment (implemented autumn 2007). Municipalities and natural persons are eligible for support but the uptake was very low so far (7 projects).

Ministry of Agriculture (MoA). MoA perceives of soil and land as an important factor of production and this is the prime motivation for soil protection in this administration. In addition, MoA tries to include the environmental perspective to land management by means of different policies.

MoA has regional offices, the Agricultural Agencies and Land Offices (Land Settlement Board). As a part of the administrative system there are institutes responsible for different areas. These institutes have a specific role in enforcing (control/monitoring) the policies. They include the Institute of Supervision and Testing in Agriculture (UKZUZ) and the Plant Protection Authority (SRS). Enforcement of rural development policies and payments transfer in agriculture are managed by the Paying Agency.

Under MoA there are the other following organisations:

Various research institutes with a focus on specific areas (e.g. soil protection, plant production, farm machinery, farm economics). In contrast to institutes mentioned above, these research institutes are not involved in the administration of policies but rather in research in the area of natural and social sciences and support for the design and evaluation of policies.

The most important institutes for soil protection are: Research Institute of Soil and Water Protection (VUMOP), the Research Institute of Forestry and Game, the Institute for Forest Management (UHUL), the Research Institute of Plant Production and partly the Institute of Agricultural Economics and Information (UZEI).

The Institute of Agricultural Economics and Information is responsible for support of agriculture policy design and information transfer in agriculture and the supervision of the farm advisory service (e.g. providing certification and training) and thus supporting the implementation process of most of the MoA policies.

MoA and its relevant organisations are consulted in case of Law on soil protection design or amendments.

This Ministry operates a number of policies relevant to soil protection:

- Agri-evironmental schemes (e.g. conversion of arable land to grassland and cover crops),
- Land consolidation,
- Cross compliance GAEC standards,
- Action plans under the Nitrate Directive (in NVZs).

Land consolidation is a planning measure and is implemented by Land Settlement Boards (part of the MoA), which are present in most of the regions (NUTS 4).

Regulatory measures (command and control) are mainly provisions under the umbrella of the Nitrate Directives and cross compliance GAEC standards. Both policies are designed in cooperation with MoE. Nitrate Directive requirements are monitored by UKZUZ and GAECs are monitored by the Paying Agency.

Other governmental organisations – Universities and Academy of Sciences. A number of universities are active in the area of soil protection. Mendel Agricultural and Forest University Brno, the Czech University of Life Sciences, and South Bohemia University Ceske Budejovice carry out applied research on soil protection. Some key personnel of the Brno

University of Technology are involved in policy design on soil protection. The Institute of Soil Biology of the Academy of Science carries out basic research in the field of soil protection.

6.2.2 Civil society and non-governmental organisations

Farmers' organisations involved in soil protection. The most powerful stakeholders concerning soil protection which are not operating as government organisations are farmers' organisations. The largest organisation is the Agricultural Chamber (AK) that has offices at the regional level, i.e. NUTS3 and NUTS4. Other organisations are: the Association of Private Farmers (ASZ), the Association of Landowners, the Agricultural Association and different associations of specialised farmers (e.g. cattle, goats, and sheep keepers). The Association of Marginal Areas represents farmers operating mainly in LFAs. The last association's members are farming mostly on grassland and therefore soil protection is not one of its priorities.

The two most active actors, AK and ASZ declare that soil protection, especially erosion prevention, is their priority. However, ASZ is little bit more active in this field and their demand for the state's leadership regarding soil protection is strong. One of the explanations could be that the Agricultural Chamber acts as a representative of large farms (not solely but frequently) with most of the land hired from a large number of small owners (frequently not living in countryside or not working on the particular farm). Therefore it is assumed that the large farmers have a different ownership pattern than family farmers. In contrast, ASZ represents family type farms, which prefer private ownership of land and long term planning for land management (e.g. planning to pass the farm to the next generation).

There are no NGOs that are influential on national level or acting widely in soil protection policy design or implementation. No local initiatives in soil protection could be identified but of course there are farms where soil protection is taken seriously and relevant measures are applied.

Some NGOs act on the regional level trying to pursue soil protection on specific hot issues especially when development interests could cause high quality soils being used for construction. These two organisations are Arnica and the Association for Soil Protection in the Czech Republic. Arnica's activities are usually ad hoc (from case to case) and Association for Soil Protection was not recognised as a partner for policy development on national level.

Resources, capacities and networks. The information on resources, capacities and networks of various organisations are based on the interviews conducted with stakeholders. The following networks can be distinguished. They are tabulated for better overview.

Network associated with Law on soil protection:

Organisations	**Roles**
MoE, MoA, (to small extent MMR).	design and implementation
Regional governments, municipalities	implementation and enforcement
CIZP, UKZUZ, AOPK, Czech Geological Service	implementation and enforcement
VUMOP, VURV, UZEI, UHUL, VULHM, the Institute of Soil Biology of Czech Academy of Science, Universities	mainly policy design
Farmers' organisations: the Agricultural Chamber (AK) and the Association of Private Farmers (ASZ)	Lobbying, policy design
NGOs: the Czech Society for Pedology, the Society for Soil Protection – civil society	promoting soil conservation on local level, lobbying

MoE is regarded as the most influential in this network.

Network associated with land consolidation:

Organisations	Roles
MoE, MoA, CUZAK, Chamber of Land Consolidation	design and implementation
Regional governments, municipalities, ZVHS and water authorities	part of implementation
Paying Agency	implementation, control
Cadastre Office	accepting result of the project expressed in maps
Research bodies: VUMOP, UZEI, UHUL, VULHM, Institute of Ecology of Forest, Universities	mainly in policy design
Farmer's organisations: the Agricultural Chamber (AK) and the Association of Private Farmers (ASZ),	Partners in negotiations on erosion prevention measures
NGOs: the Czech Society for Pedology, the Society for Soil Protection – civil society, the Association of Small Municipalities, the Association for Renewal of Rural areas	stakeholders in consultation process of the project

MoA (Land Offices) is regarded as the most influential in this network.

Network associated with agri-environmental schemes:

Organisations	Roles
MoE, MoA, CUZAK	design and implementation
MoA, MoE and AOPK, (UZPI).	design and implementation
Paying Agency	implementation, control (sometimes invited to design but normally consulted)
Regional governments (the Association of regions)	normally consultation but they can influence directly policy design
Research bodies: UZEI, VURV	mainly in policy design
Farmer's organisations: the Agricultural Chamber (AK), the Society of Young Farmers, the Association of Private Farmers (ASZ), the Association of Marginal Areas, the Agricultural Association	usually consultation
NGOs: Bioinstitut, PRO-BIO (representative of organic farmers)	consultation process

MoA is regarded as the most influential in this network.

Network associated with Nitrate Directive – NVZs Action plan:

Organisations	Roles
MoE, MoA	design and implementation
UKZUZ (partly also CIZP)	control and enforcement
Research bodies: VUMOP, VURV, UZEI, Universities	mainly in policy design
Farmer's organisations: the Agricultural Chamber (AK) and the Association of Private Farmers (ASZ)	consultation process

MoA is regarded as the most influential in this network.

Policy design

The organisations under an umbrella of Ministry of Environment (MoE) deal mostly with regulatory framework (Law on soil protection). The design process is rather difficult because the power distribution between MoE and Ministry of Agriculture (MoA) is not even and therefore either the Law is weak or the decisions are taken with significant delays. The Law on soil protection is designed in cooperation with Universities and in consultation with MoA, regional government, and municipalities and in a lesser extent with NGOs.

MoA leads design process of the land consolidation. This process is carried out with Universities and research institutes (e.g. VUMOP) in consultation with MoE. An important partner is the Chamber of Land Consolidation which plays a key role in the design and consultation process.

Also agri-environmental schemes are designed under MoA with a wide cooperation with several organisations under MoE (e.g. AOPK) and NGOs (e.g. Bioinstitute, PRO-BIO). Farmer's organizations are consulted. The reason is a wide range of schemes with different subject (e.g. water, soil, biodiversity) which require several partners. The design process lacks in many cases good solid initial studies helping in well targeted and designed measures. There are attempts to lobby for more favourable conditions in schemes (usually payment level) during the design process by farmer's organisations which. Concerning design of soil conservation measures the network is rather simple (MoA, Universities and two research institutes, i.e. UZEI and VUMOP) and lobbying was not experienced. There is rather long list of organisations involved in consultation process (see tablulated overview above).

The Action plan in the framework of the Nitrate Directive is designed under the lead of MoA and especially by research institutes (mainly VURV, VUMOP, UZEI) and partly Universities, and in close cooperation with MoE. The measure is quite policy sensitive because of its requirements, that lead to heavy investment in farming (especially to manure storage capacities). Farmer's organisations and MoE are key partners in the consultation process.

Implementation process

The implementation of the Law on soil protection has obstacles. Firstly because the law is weak in many instances it is not possible to enforce it and relevant institutions responsible are week also for that reason. Secondly there are conflicts of interest on regional level when deciding on the protection of particular piece of land. There are not evaluation studies carried out concerning this policy.

Land consolidation process is run by Agency under MoA, which has its offices in regions. Particular projects are carried out with wide participation of all key regional and especially local players, both government/non-government. The process is rather difficult and requires effort from project leader (usually hired specialised organisation) to manage great number of interest groups/individual. Because of significant power of land owners and managers in many cases some soil conservation measures are not agreed. Low budget does not allow for

to speed up the process and the progress is slow. The evaluation of the effect of the Land consolidation process is rather rare.

Agri-environmental measures are implemented by MoA and Paying Agency (following EU rules). Implementation is supported by seminars on regional level carried out by Agricultural Agency and MoA. Other source of information is internet and general information could be provided by advisors. There is not enough advisors and those available are not usually able to provide specific advice concerning soil protection. The effectiveness of the agri-environmental measures is not regularly assessed.

Implementation of the Action plan in the framework of the Nitrate Directive is rather smooth. There was quite massive information campaign carried out in time of the Action Plan implementation. The implementation is supported by quite sophisticated web site guiding farmers to precise requirements specific to their field and to steps needed for compliance. Advisors were trained and supported to provides advice concerning compliance with the Action Plan for several years. The compliance is controlled by UKZUZ (organisation under MoA) and quite small percentage of non-compliance is reported. There are regular evaluation studies carried out under this policy.

For more details of design and implementation of policies please see relevant fiche and comments in chapter 7.

6.3 Conclusions

The key actors in the process of policy design are MoE (Law on soil protection) and MoA dealing with other policies related to soil protection. There are several other actors which support the work of both Ministries. These are mainly research institutes and Universities. They are usually requested to design the proposal together with the Ministry in so-called “working groups”. In some particularly sensitive issues farmers’ organisations may become involved. The largest farmers’ organisations are the Agricultural Chamber (AK) and the Association of Private Farmers (ASZ). But in most cases these actors are consulted after the policy was designed (or at a final draft stage).

Some specialised organisations are responsible for the administration of relevant policies including the implementation, control, and enforcement. These are the Paying Agency, UKZUZ, AOPK and others.

NGOs are not involved so much in the policy design but several of them are consulted. Some NGOs are active at the local level, where they may lobby for land protection.

Among interviewees there is a rather uniform attitude concerning the division of responsibilities. Most of the policies relevant to soil conservation (incentive based, project based, command and control) are implemented under MoA but the key legislation on soil protection (command and control) is implemented under MoE leadership. Most of the respondents believe that MoE is weak in pursuing the amendment of relevant legislation and that it has even less ability to enforce existing legislation. Policies under MoA do not cover all issues, therefore most of the respondents stated that there are gaps in policies (e.g. some issues are not covered or covered insufficiently). In contrast, MoA policies are generally enforced and overall with sufficient efficacy (partly because EU administrative rules are implemented). As a result there is an acceptable level of compliance with policies under MoA. However, in some cases this results in not very demanding measures (e.g. GAECs). Lack of trust between the Ministries decreases the effectiveness of the policy design and consultation process (e.g. usual practice is to send document for comments at short notice).

On the other hand some respondents give higher value to permanent measures implemented in the framework of land consolidation than the rather short to medium term agri-environmental schemes. In contrary some respondents stress that agri-environmental

schemes cover a significant part of sensitive areas and already have positive influence on the soil degradation.

Key actors (e.g. MoE, MoA, research institutes, universities) accept the fact that some soil degradation processes have alarming consequences (e.g. soil erosion leading to siltation of reservoirs). The most influential actors in particular action arena are:

- Farming practice action arena – research institutes (e.g. VUMOP) and universities (e.g. University of Technology Brno),
- Policy design: MoA for policies under MoA responsibility and MoE for Law on Soil Protection,
- Policy implementation: Municipalities, regional governments and MoE in case of Law on Soil Protection and the Paying Agency, UKZUZ, SRS, SVS in case of cross compliance, Nitrate Directive and instruments supporting farmers for particular farming practices.

7 Policies for soil conservation

7.1 Existing policies and their classification

The most important policy measures concerned with soil conservation are summarised and classified in Table 10. They include the Law on Soil Protection, the Nitrate Directive, Agri-environmental schemes, and Land consolidation and specific comments will be provided with the fiches (at the end of section 7.2). There is quite a sophisticated advisory tool dealing specifically with the implementation of the Nitrate Directive.

There are no policies falling in the category of Moral Suasion Initiatives or Information and Capacity Building measures. One of the reasons is that soil protection is not a priority in the Czech Republic and therefore there is not enough attention to this topic among farmers, policy makers and public administrators.

Table 10: Classification of policy measures in the Czech Republic

Type of Policy Mechanism/ Mode of governance	Practical classification Nature of the Policy Objective			Policy relationship to agriculture	Geographical level	Analytical classification – Channels of Impact Primary (1) and Secondary (2) impacts. Y = Yes, N = No		
	Soil conservation is the **primary objective** of a policy measure	Soil conservation is the **secondary objective** of a policy measure	Soil conservation is a **By-product**	Agricultural (AG) or non Agricultural (NAG) focused policy	European (E), national (N), regional (R) or local (L) measure, and policy reference	Developing new/altering existing rules (institutions)	Developing and/or altering governance structures/ implementation approaches	Directly impacting on farmer behaviour/ decision making/ factor allocation and management practices
Command and Control	Law on Soil Protection			AG	N	Y	N	N (2)
			Nitrate Directive	NAG	E	Y	Y	Y (1)
Incentive based measures/economic instruments	AES - Arable conversion to grassland			AG	E	Y	Y	Y (1)
	AES - Cover crops			AG	E	Y	Y	Y (1)
		Land consolidation (planning type)		AG	N	Y	Y	N (1)
Moral Suasion Initiatives ie it has a normative dimension that farmers should protect soils								
Information and capacity building measures								

Source: own observation, policy documents (see Annex).

7.2 Description, analysis, and evaluation of policy measures

There are not many policy measures, which could have a significant effect on soil protection. Selected measures are analysed in this section in form of fiches. For this analysis the following key policies were selected:

Law on soil protection. This is the key legislation in the Czech Republic concerning the protection of soil from permanent loss (e.g. construction) and quality deterioration (degradation). It is designed and implemented by the Ministry of Environment (MoE), with the design taking place in cooperation with the Ministry of Agriculture (MoA). There is high potential for soil conservation in this law but this is not fully utilised.

Land consolidation (based on the law on land consolidation and Land Settlement Boards/Land Offices). This process contains compulsory measures concerning soil conservation (part of law on land consolidation). The process is project-based with intensive involvement of all stakeholders. The soil conservation measures entail permanent changes in land use organisation (e.g. rearrangement of plots in relation to slope) and several types of landscape features (e.g. field banks, field roads, dry polders) are paid from national and EU financial resources (partly from EAFRD).

Agri-environment schemes. Two measures are relevant to soil conservation (conversion of arable land to grassland and cover crops) and are supported from the EU budget with national co-financing. They are regarded as powerful means of short-term to long-term measures preventing soil erosion.

Nitrate Directive (government decree No. 103/2003 on designation of nitrate vulnerable zones (NVZs). Use of fertilisers and manure, plant rotation and erosion prevention measures in these areas): Its main goal is the prevention of nitrate loss but there are provisions for the prevention of soil erosion in Action programmes designed for activities in NVZs. The potential of this measure is not high as erosion prevention is not its main goal.

Information sources for the population of the fiches population are own observation, expert opinions and interviews. Additional information is included in the compilation of soil conservation measures and responsible authorities in Annex 5.

7.2.1 Fiche 1: Law on soil protection

Part A – Summary of Measure	
Formal title of measure and date of implementa-tion	Zákon 334/1992 Sb. o ochraně zemědělského půdního fondu, ve znění pozdějších předpisů. Law on soil protection, No. 334/1992 as amended in later legislation Especially the article in §3 “1) The land should be managed in a way, that the soil is not contaminated and hence food chain and sources of drinking water… and land in surrounding areas is not damaged and also favourable physical, biological and chemical properties of soil…”.
Short description of the measure	Law defines rules for: a) withdrawal of agricultural land from production and approving its other use (e.g. construction), i.e. the law should prevent un-justifiable use of agricultural land for other purposes, b) protection from soil degradation, allowing for penalisation of soil damage. The first part is used in daily decision making on local/regional level when application for development projects on agricultural land appear. The law was introduced at the beginning of 1990s and amended several times, although not substantially.

Type of policy measure	Command and control. A regulatory measure that deals with all major damages of soil from abuse to serious degradation. In general the policy should prevent loss of soil as a natural resource and also as a factor of production in agriculture. This is done by rules for use of agricultural land for other purposes combined with levies.
Objective of policy measure and relevance	To protect soil as a natural resource as such (no loss of land for other use) and its quality (prevent "damage of biological, physical, etc. properties of soil").
	How relevant are the objectives of the measure to the soil degradation threats in your region? □ □ □ □ ⊗ Not very Very
Indirect effects	None
Linkages to other policy measures	Linkage to Czech regulation on construction, to EU-Nitrate Directive, to local development plans
Funding	None
Summary of assessment and conclusions	The measure is rather strong in prevention of inappropriate use of land (e.g. for construction) especially in cases of small construction works, but it fails to be successful if there is a strong lobby. The measure fails to protect soil quality because it is not enforced, the definition of compliance failure is vague, and penalties are used rarely. The law is used to force farmers when they cause external effects that represent a threat to human lives or damage on properties. There are not enough stakeholders involved in policy design and the final consultation is not regarded as sufficient. There is an intention to amend the law substantially and the process already started but actors are now awaiting the adoption of the EU Soil Framework Directive which could help boost political will. Among new rules there should be a new directive dealing with soil erosion. Among others the motivations for amendments are reflecting failures mentioned in boxes above. Some respondents recognised this law as the most important measure for soil/land protection but mentioned that the potential of this measure is not fully used.
Recommenda-tion	To improve enforcement, reformulation is needed in a sense of more precise definition of 'damage of soils', definition of 'failures in compliance', and related penalties. The fees collected when agricultural soils are intended for construction should be higher.
Part B – Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The law was designed as a national law under the leadership of MoE with assistance of MoA (regarded as not sufficient). Other authorities are consulted if there is an intention to amend the legislation. Especially research institutes and universities are active and invited to support the law design. It is regarded that the cooperation among key organisation on the rules design is not effective and is frequently difficult. Several organisations are invited for consultation (e.g. regional governments, The Association of Cities and Municipalities, farmer's

	organisations, NGOs). The consultation process is described at the end of this section. Some organisations feel that more partners should be involved in policy design and not only in final consultation. This kind of rule is decided between MoE and MoA with great difficulties. It is apparent that the division of responsibilities and cooperation style is not favourable to the process.
Policy implementation I: Implementation at administrative level	This policy is enforced at the regional level (regional government at NUTS 3 level) and municipality level (municipality with extended responsibilities, class 3) if the area in concern is not large. If the case is very important (large area of agricultural land in question) MoE deal with the case directly. The policy is implemented by public authorities. From time to time there are cases where a municipality is interested in using agricultural land for other purposes and the relevant officer in charge of enforcement of the Law for Soil Protection does not have enough power to resist and protect the land.
Policy implementation II: Method of delivery to farmers	Farmers or other landowners submit an application for exclusion of agricultural land from production and for other use of land to an officer dealing with environmental matters in the relevant administration. The application is forwarded to the right level (small acreage at local and larger areas at regional level). After an assessment of the case the decision is made and when the application is approved a fee is calculated and collected (a part of the fee is used on local level). Information required for the proper implementation is transferred mainly by the training of officers on the regional/municipal level (also done by brochures). The assistance of farm advisors is rare on this matter, no advisor on this matter was identified in the case study area. There is enough capacity for current numbers of applications at the local and regional levels, while the capacity at the national level seems to be insufficient.
Targeting	Application of the law is targeted by higher fees when the agricultural land in concern is in protected areas (different fees with different degree of protection), e.g. water protection or nature protection areas. The different (higher) fees are collected from legal rather than from natural bodies.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? □ □ ⊗ □ □ Low High
What Drives Uptake?	The only motivation for adhering to the policy is the obligation to follow the rules for change of the land use from agriculture to other types of use. There is no motivation based on this policy to adhere to soil quality preservation because the requirements are vaguely formulated.
	⊗ □ □ □ □ Obligation Financial incentive Information & support Exhortation Other
Technical measures	There are no technical measures defined.

Enforcement and control	The administration which approves of the conversion of agricultural controls only those cases where there is potential for non-compliance (and all large cases e.g. the soil management in surface mains). If smaller areas are concerned e.g. for building a family home on former agricultural land, the case is not normally controlled, because the administrative procedure is sufficient for enforcement. The respondents on the national level believed that about 95 % of cases are finally controlled but interviewees on the local level estimated the rate about 30 %. In the cases where off-site damages arise (e.g. mud on roads), the relevant administration claims from the farmer who caused the problem to replace the damage. There is no capacity for enforcement available to prevent such cases. For example it is possible to order the farmer to convert arable land on a slope to grassland but when the negative economic impact is proved the government would have to compensate for lost income. This rule discourages enforcement of these rules.
Monitoring and evaluation	Local and regional administrations provide statistics on all cases of the conversion of agricultural land to other use regularly but the formal evaluation of the success of the policy is not undertaken. The effect of the rules on the quality of soil is not monitored and it is expected to be close to "no effect".
Outcomes of policy measure	It is difficult to assess the outcomes of this measure concerning conversion of agricultural land to other uses. Most of the cases are formally well-decided and therefore seemingly providing right outcomes. But interviewees reported that several cases were not well decided and there is no evidence of such cases. Nearly no or only a moderate outcome is expected when assessing protection of quality of soil.
Analysis of drivers of policy measures' outcomes	The compliance is driven by fines and fees as well as by the rules set and amended during the last 16 years.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	Concerning the prevention of a permanent loss of the agricultural land (e.g. for construction) the measure is rather effective especially in case of small areas in question. The measure is much less effective if there is a large development envisaged and the lobby is strong. The law is not effective for the prevention of soil degradation at all; although it has provisions for a fine application. Therefore the rules do not reflect actual threat to soils. The measure is not unnecessary costly in general terms but because some outcomes are questionable the overall efficiency is not high (especially regarding soil quality). There is not any mechanism to evaluate the outcomes of the measure.

Constraints to achieving full potential of the policy measure	The strong lobby for development projects and vague wording of the law are the main constraints. Several respondents feel that the general constraint is the lack of a feeling of ownership towards the land. A large part of land is rented. Land owners are both far in space or in time, i.e. they lost the feeling for the value of the quality of land, and land managers do not feel enough responsibility for maintaining long-term soil quality.
Reasons for the success of the policy measure	There are cases where the soil is preserved for agricultural purposes. It is assumed that the driving force is deterring effect of fee, which should be paid for the conversion of the purpose of land use (usually households).

7.2.2 Fiche 2: Land consolidation

Part A – Summary of Measure	
Formal title of measure and date of implementa-tion	Land consolidation process stems from Law on Land Consolidation and on Land Settlement Boards, No. 139/2002 Coll. As amended in later legislation (No. 309/2002 Coll.). Pozemkové úpravy vycházející ze Zákona č. 139/2002 Sb. O pozemkových úpravách a pozemkových úřadech, ve znění pozdějších předpisů. A number of articles are especially relevant to soil protection:
Short description of the measure	The measure is project-based and has its primary aim in the consolidation of ownership and the management structure of land registered in a cadastre (e.g. ownership is fragmented). At the same time the relevant law makes provisions to design the management structure and landscape features in a way which is favourable for soil protection (e.g. field banks as erosion prevention). Thus, suitable organisational and technical measures are proposed and finally agreed. In addition, farming practices are suggested by the project managers, but mostly not implemented by the farmers Background: The measure was introduced because after decades of command and control regime the ownership was not in a favourable state (e.g. fragmented ownership, difficult to identify individual fields in large field blocks, the land was not accessible for its owners). The measure is usually applied on cadastral level and the final aim of the project is to reallocate land in the cadastre to assure its availability, more effective use (merging some fields) and at the same time to introduce on the cadastre level several measures with value for the society so-called Common Facilities (e.g. soil protection measures, measures preventing fast water runoff, ecological networks). The measure has been implemented for more than ten years and it is expected it will be further fostered (e.g. by larger budget). Currently, 12 % of all necessary land consolidation projects in the cadastres are either finished or running.
Type of policy measure	Project and development measure.
Objective of policy measure and relevance	To consolidate ownership structure in order to make land available to owners and in addition to design technical measures to protect soil against erosion and water runoff. It is regarded as very relevant, because the measures in favour of erosion prevention are permanent (e.g. field banks, bio-corridors).

	How relevant are the objectives of the measure to the soil degradation threats in your region? □ □ □ ⊗ □ Not very Very
Indirect effects	Some landscape features implemented (e.g. tree belts, field banks) has significant ecological value and new land use patterns have significant influence on water quality and quantity (e.g. decrease of surface water runoff).
Linkages to other policy measures	To the Law on Nature Protection, the Law on Soil Protection and the Law on Environment Protection.
Funding	The whole process is funded from national budget (from mid 90s) and after EU accession also partly from EU budget for rural development (EAFRD). Of particular importance for soil protection is funds spent on landscape features (called “common facilities”). The funding of the whole measure and especially of erosion prevention measures was not sufficient until the end of 2007 but now there is the intention to support the measure more.
Summary of assessment and conclusions	The measure is quite effective but it depends a lot on the personality of the person leading the project and her/his perseverance to pursue soil protection, or on the quality of the firm providing the design and guidance of the whole project. In many cases farmers are not in favour of some proposals for soil conservation (e.g. division of field on slope or conversion of arable land to grassland). This measure cannot provide a comprehensive solution for soil protection since it does not enforce proposed farm practices and its uptake is growing slowly. However, it should be applied as a part of a broader and integrated policy set.
Recommen-dation	• To improve the document “Guidance to project managers” (developed by the leading research institutes and universities in the Czech Republic) and to give this document more power. This should help in proposing more demanding requirements concerning projecting of soil protection measures. • To build further capacity of administration to manage the process (especially personnel in some regions and their training). • To coordinate work of the Land Fund with the Land Settlement Board (Land office). The Land Fund is able to sell state land in the cadastre where such a piece of land is needed for a land consolidation process (sometime it is necessary to purchase some land). • To increase the general awareness about the value of soil conservation measures among farmers and inhabitants in rural areas. • To make this measure enforceable for example by defining a limit for erosion (max. t/ha) which is important for the enforcement of policy measures.

Part B – Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The law was designed as national law under the leadership of MoA (the Central Land Settlement Board) with assistance from key research institutes and universities including the Chamber for Land Consolidation. Other authorities are consulted if there is an intention to amend the legislation (for the description of the consultation process see at the end of this section). Research institutions and the Chamber of Project Managers are participating in design of the measure; in later stages all relevant bodies are consulted (from state administrations to NGOs). It is perceived that the communication of relevant bodies in the process of policy design is not very effective especially because this measure was not a priority for the previous administration. There is no formalised approach to communication among the partners participating in the policy design and problems are solved ad hoc. There is a potential conflict of interest in case of the Chamber for Land Consolidation, which is composed of beneficiaries or organisations which are selected for the project's design and implementation.
Policy implementation I: Implementation at administrative level	Policy is implemented an local level i.e. cadastre level (lead by the Land Settlement Boards at NUTS 3 level). The Land Settlement Boards issue calls for tender for project design, inform stakeholders (e.g. farmers, land owners, municipalities and relevant authorities e.g. officials in nature protection). Project managers of the firm which won the tender lead the process and the final implementation of proposals by specialised firms. The process of land consolidation is either initiated by land owners or in the interest of society (e.g. need for new infrastructure). The Land Settlement Board creates a Committee of Representatives which is the key partner for the whole process. Committee members are representing local landowners' interests. The Committee's recommendations should be taken seriously since it approves the proposals for land consolidation. In many cases the creation of such a body is influenced by informal rules at the village level (e.g. local leaders, farmers, or the mayor should be contacted first to tap into local social capital). Additional key stakeholders are land managers, municipality, administrations of protected areas, water authorities, regional governments, administrations responsible for infrastructure (e.g. water supply, transport). The management of the measure is not flexible enough because the regional Land Settlement Boards are not independent enough and most of the decisions should be agreed on national level. There is enough information for successful implementation of this measure but some of it is not available to all stakeholders (e.g. project managers do not have access to LPIS, digital model of terrain, etc.).
Policy implementation II: Method of delivery to farmers	The information flow and the consultation process are managed by the Land Settlement Boards. Proposals should be agreed by key authorities in region (e.g. nature protection, water protection, environment protection). Farmers and other stakeholders are informed by the Land Settlement Boards at the beginning and during the process of land consolidation.

	The administrative process is sufficiently supported from national sources. The priority of this measure is growing and therefore there is a shortage of administration capacity in some regions. Other information support than that managed by Land Settlement Boards is rare. In rare cases the process fails and land owners could even bring the case to court (e.g. disagreement on particular field boundaries or field exchange). Administrative process of land consolidation - simplified: • Explanation of the purpose to municipality. • Announcement to landowners, land managers, and other stakeholders. • Creation of the Committee of Representatives. • Design of proposals by process manager. • Proposals agreed by local government (municipality). • Stakeholders are invited for comments • Comments are communicated, agreed or rejected by other stakeholders and implemented • Agreed documents have form of decision.
Targeting	The measure is project-based; therefore all measures proposed in the process of implementation on local level are highly targeted at local needs. There are not specific target groups or regions.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? □ □ □ □ ⊗ Low High
What Drives Uptake?	Need for reorganisation of land ownership and land management in cadastre and need of municipality (potentially other authorities) for final decision on land ownership for spatial planning (for design of Development plan which is key document for future decisions on area use). For the process both land owners and municipalities are usually highly motivated (currently there are more applications than really running projects).
	□ □ □ ⊗ □ Obligation Financial incentive Information & support Exhortation Other
Technical measures	The core of the process is reorganisation of fields (e.g. change of shape, position/location in cadastre) and the second step is a proposal for any kind of specific farm practice, which fit to the local needs for soil protection. Introduced permanent measures (e.g. shape of fields, field banks) influence farm practices indirectly. Examples of the technical measures implemented during the land consolidation: field banks, ecological network/bio-corridors, conversion of arable land to grassland (whole fields or grassland strips across the slope, grass on preferential ways of water runoff), field roads, ditches, and dry polders.
Enforcement and control	The process is project based and relies to a great extent on the consensus of key actors and stakeholders. Therefore some proposals could be difficult to pursue or enforce (especially proposal for recommended farm practices). The final physical creation of landscape features is controlled by the Land Settlement Board.

	The Land Settlement Board has the right to reject proposals for action in cadastre if they are not appropriate (also to soil protection needs). On the other hand, landowners could block the implementation of some measures, thus making the final proposal less effective. In extreme cases farmers could destroy the newly constructed features and there is no powerful provision for penalising such activities. Therefore sometime it is difficult to enforce the measure, which is based more on persuasion than power. All construction work is based on contract with specialised firms.
Monitoring and evaluation	Studies evaluating of real effect of land consolidation on soil protection (e.g. real decrease of soil erosion in tons/ha) are rare (only one is known) and are not systematic and not part of the designed policy. However, the Land Settlement Boards collect feedback from the process and use it for improvement of the process. It is assumed that when a particular measure is implemented (e.g. field bank) it has benefits for soil erosion prevention.
Outcomes of policy measure	The policy measure is quite well accepted and usually supported by all key stakeholders and actors. It is assumed that introduced soil protection measures have significant impact but this is not measured so far. Several interviewees perceived that this is the most important measure concerning the soil protection in the Czech Republic (providing permanent changes).
Analysis of drivers of policy measures' outcomes	Participation in the process of the land consolidation is frequently based on demand from land owners (or most of them) therefore the need for land reorganisation (prime aim of the measure) is the main driver. This is not so clear for soil conservation measures (secondary aim) where not all stakeholders (especially the land managers) are keen to support all proposals. The main drivers for change in this measure are represented by changed rules for land use and instruments directly impacting on farmers.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	The significant advantage of the process of land consolidation is that the changes of the land use pattern in the landscape are in favour of soil protection and this change is rather permanent. The measure is rather costly but in relation to its potential for soil protection and its lasting effects it is still seen as a cost-effective measure. The fact, that some respondents from administration did not know the cost of administration, it is difficult to assess the cost-effectiveness related to administrative costs. But it is assumed that the cost level is acceptable and respondents believe that the governance structure is effective. Because the soil protection measures are based on projects it is assumed they are effective. The factor influencing capacity of the measure to solve soil protection issues in the case study area is uptake. The number of land consolidation projects is limited because of budgetary reasons (the total cost is high). The implementation of the land consolidation in all cadastres could take decades.
Constraints to achieving full potential of the	Not easy to persuade the stakeholders to agree on all needed measures for soil protection. This is due to the nature of the measure which is based to a great extent on consensus of the key actors and stakeholders. The projects are usually designed in line with the law but sometimes not fully according to

policy measure	a Manual (called “Metodika”) describing the recommended approach and what specific studies and measures should be undertaken and implemented. This weakens the potential effectiveness of the measure. Another major constraint is the available budget.
Reasons for the success of the policy measure (where appropriate)	There is enough experienced project managers who knows the ways how to manage whole process. The main reason for success in soil protection is that the measure is based on projects specific to the local conditions and that the measures are rather permanent.

7.2.3 Fiche 3: Agri-environmental measure

Part A – Summary of Measure	
Formal title of measure and date of implementa-tion	Agroenvironmentální podopatření: Zatravňování orné půdy a pěstován meziplodin. Agri-environmental schemes: Conversion of arable land to grassland (from mid 90s) and growing cover crops (from 2004). The policy is implemented in the framework of Rural Development Plan.
Short description of the measure	Farmers are supported to convert the arable land to grassland and priority is given among others to sensitive soils (e.g. on slopes or those close to water bodies). The benefit of grassland introduction is based on the assumption that on grassland soil erosion is reduced to a minimum and water runoff is decreased. Support for growing cover crops is granted at any place as it is assumed that there is benefit generated at any locality. Based on research results it is assumed that cover crops reduce soil erosion, reduce surface water runoff on arable land, fix nitrogen, and prevent nitrogen loss to some extent. Both schemes will continue at least until 2013 to the end of the current programming period.
Type of policy measure	Incentive instrument. Both measures are targeted at arable land and farmers receive financial support for introduction of relevant activities and therefore for services for society. The conversion to grassland is supported on basis of income foregone, cost incurred and possible savings. The growing of cover crops is supported on basis of cost incurred.
Objective of policy measure and relevance	The aim is to protect soil from degradation, especially from soil erosion. Both schemes slow down water runoff and growing covers crops is expected to reduce nitrate loss.
	How relevant are the objectives of the measure to the soil degradation threats in your region? □ □ □ ⊗ □ Not very Very
Indirect effects	Grassland is usually valuable also for its ecological value in the countryside. Cover crops are expected to prevent part of the nitrate loss in soils and to improve the quality of soils.

Linkages to other policy measures	Cross compliance is a baseline for this measure. If farmers do not comply to cross compliance, the payments may be reduced. There is also a link to LFA payments.
Funding	The measure is funded from EAFRD through Rural Development Plan (both EU and national budgets). For both schemes the funding is sufficient.
Summary of assessment and conclusions	The measures are quite effective for erosion prevention and other environmental positive effects. AES conversion has been implemented for more than ten years and it was rather successful in protection of sensitive soils in the Czech Republic. AES cover crops is already running for five years and has been very popular among farmers. The schemes' effectiveness could be increased if there is stricter targeting (e.g. grassland introduction supported only on sensitive soils). Another weakness is that the cover crop scheme is a short-term solution with no guarantee that it will continue. The conversion of arable land to grassland is regarded as medium-term solution. Changes in the price of commodities will effect the payments especially in case of grassland introduction (payment should increase). It is likely that the rest of the conditions for both schemes will remain the same in the near future. A critical point is the timing of the legislative process before the call for applications for AES. Each year the process is in a hurry and there is not enough time for proper explanation of the schemes and their innovations to farmers. The time available to farmers for filling in the application is insufficient.
Recommenda-tion	Both schemes are beneficial and should be maintained. The recommendations for scheme improvement are as follows: • Better targeting: Restrict grassland introduction to sensitive soils and adjust payments to changes on the agricultural market. Growing cover crops should be regionally targeted by means of different dates for sowing. • If ploughing of grassland was allowed (not the case now), then more farmers would apply for conversion of arable land to grassland. Now they fears they will be "trapped" without the possibility to return to arable land. This issue is highly controversial and under discussion. • To improve timing of AES funding applications in order to allow time to train farmers and transfer information.
Part B – Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The measure was designed by MoA with minor support of MoE. These schemes are not controversial. All key stakeholders were required to provide comments on the proposal (see description of consultation process at the end of this section). There is close cooperation on the policy design between MoA, UZEI, VURV, and partly MoE (introduction of species rich grasslands). MoA use the Monitoring Committee for Rural Development as a forum for the discussion of agri-environmental measures. The forum works quite well. Based on results of the discussion, feedback is directly collected from disappointed farmers for amendment of the measures.

Policy implementation I: Implementation at administrative level	The implementation is supported by the Agricultural Agency (part of MoA in regions, usually NUTS 4 level) and the Paying Agency (also in regions). The governance structure is quite effective in administering both schemes. Farmers submit application forms to the Agricultural Agency (where extensive help is usually available) and after administrative control the application form is passed to the Paying Agency which provide payments and control/decide on penalties in case of non-compliance with prescriptions. Procedures for implementation and control are quite formalised. The following factors are important for successful implementation: information provision to farmers (partly provided); implementation by project approach (sometime ad hoc and there is not prepared "road map"); use of a common terminology; involvement of the key stakeholders (not relevant stakeholders all are involved, especially NGOs); pilot studies (not used at all). There are usually delays in the implementation process, which is repeating every year. As a result there is not sufficient time for proper information provision to farmers and for filling in the application forms (farmers are frequently confused).
Policy implementation II: Method of delivery to farmers	Advisors are trained on this matter and there is a certification system for this purpose. However, it is regarded that the advisory services does not fulfil their role sufficiently. The main failure is that farmers do not understand the purpose of the schemes. Regional officers of MoA attend seminars and are trained to in turn provide seminars to farmers in region and explain the key issues associated with these measures. UZEI and the Agricultural Chamber (AK) are following the same approach. However, AK is not active in all regions. Information flow should be improved because the purpose of the schemes is not explained to the farmers sufficiently.
Targeting	Growing cover crops is eligible on any arable land. Conversion of arable land to grassland has rules where it is possible to target the scheme on vulnerable soils. There is an exception that farmers could implement this measure also on non-vulnerable soils in LFA areas. Grassland should be cut and for proper management it is necessary to announce dates of mowing or time intervals. The dates should vary according to regional climatic conditions but there are only common dates for the whole country.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? □ ⊗ □ □ □ Low High
What Drives Uptake?	Financial support, and reduction of support when non-compliance is found.
	□ ⊗ □ □ □ Obligation Financial incentive Information & support Exhortation Other

Technical measures	The conversion of arable land to grassland: This activity was rather common when the scheme was introduced but the scheme increased the uptake. The scheme has simple prescriptions with few options (e.g. introduction of biodiversity rich grassland in some areas). Cover crops: Before this scheme was introduced the relevant practice was rare on Czech farms. The prescription is rather simple.
Enforcement and control	This is done by the Paying Agency according to the rules of the EU on sample selection (risk analyses), type of control (administrative and on the spot) and size of the sample controlled (minimum 5 %). The Paying Agency can impose penalties if non-compliance is recognised. Compliance is driven by fear of punishment. Means in facilitating control process include GIS, administrative control, control on spot, and remote sensing.
Monitoring and evaluation	The responsibility lies with MoA, but this is still not well established (e.g. not enough financial funds, hierarchy does not see it as priority). Especially the evaluation of real impacts of the schemes was not done so far. The feedback on functioning of the schemes is collected from farmers and used for amendments of the schemes.
Outcomes of policy measure	Both schemes are very popular and the uptake is sufficient, cover crops uptake is actually limited by the budget for rural development. It is assumed that the schemes are successful in achieving their goals (scientific arguments) despite the fact there is no evidence from relevant studies.
Analysis of drivers of policy measures' outcomes	The first driver is the financial incentive. The second driver is the risk associated with non-compliance of having to pay back part of the support. The outcomes are achieved by introducing instruments directly influencing farmers' decisions. The need for enforcement of the schemes led to the enforcement of other rules that were weak before (e.g. baseline rules on fertilisers' management).
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	Both policies are regarded as rather effective (including cost-effective) but these are not permanent solutions. Where grasslands were introduced the soil erosion is assumed to have decreased to a low level. It is likely that a significant part of the activity was undertaken on sensitive soils (it has such targeting and farmers are shown on maps where the sensitive soils are) and therefore the measure is effective. Growing cover crops was a rare practice before the scheme's implementation. Since cover crops have positive effects on soil conservation this measure is also assumed to be effective. From 2007 the payment was decreased and therefore next years will show to what extent the uptake will be effected.
Constraints to achieving full potential of the policy measure	The budget for rural development and the fluctuation in agricultural commodity prices represent the main threat for the conversion of arable land to grassland. In case of extremely high agricultural commodity prices farmers could tend to plough some of the converted grassland again. Grassland introduction has basically two areas of priorities: soil protection (targeted at sensitive soils e.g. on slopes, shallow, close to water bodies) and conversion of arable land in LFA. To some extent the competition of

	these two types of targeting could cause a decrease of effectiveness concerning soil protection. Another constraint is the inconsistency with other policies as GAECs form a baseline which is not clearly defined and easy to comply with.
Reasons for the success of the policy measure	A significant part of farmers recognises soil erosion as the main degradation issue. During communist time a lot of grassland was ploughed up in localities not favourable for arable farming (e.g. on slopes, remote and small fields) and therefore these fields were attractive for conversion. In addition, there is quite a long-term support for grassland management and farmers are able to plan their business activity to this end. In the case of cover crops the main reason for its success was the favourable situation in technologies (e.g. reduced tillage) of some farmers, which made the measure technically easy to accomplish. As a result the group of "winners" in the scheme was large enough to cause sufficient uptake.

7.2.4 Fiche 4: Nitrate Directive and national relevant legislation

Part A – Summary of Measure	
Formal title of measure and date of implementa-tion	Nařízení vlády č. 103/2004 Sb. o vymezení zranitelných oblastí na dusík, o používání a skaldování hnojiv a statkových hnojiv, střídání plodin a ochrany před erozí v těchto oblastech. Directive on Designation of Nitrate Vulnerable Zones and on use and storage of fertilisers and farm manure, crop rotation and erosion prevention measures in these areas No. 103/2004, Coll. Based on the transposition of the EU Nitrate Directive.
Short description of the measure	The legislation provides the framework for Action plans for Nitrate Vulnerable Zones (NVZ) which requires farmers to prevent water pollution when managing manure and soil. Concerning soil management the main interest is erosion prevention but this is not the key aim of the measure.
Type of policy measure	Command and control
Objective of policy measure and relevance	To reduce pollution of water by nitrates originating from agriculture
	How relevant are the objectives of the measure to the soil degradation threats in your region? □ ⊗ □ □ □ Not very Very
Indirect effects	Protection of water quality when erosion prevention measures are implemented.
Linkages to other policy measures	Agri-environmental scheme and LFA (requirements of the Nitrate Directive are part of the baseline for these policies).

Funding	Since this is a command and control policy there is no funding for compliance. For a limited period of time there is support for investment in storage capacities of manure (source of funding is the Rural Development Plan).
Summary of assessment and conclusions	Soil protection (erosion prevention in this case) is not the main aim of the Nitrate Directive and it is targeted at NVZs only. Therefore this is not regarded as the most influential measure for soil protection because limited area is involved and erosion prevention is considered when this has a significant influence on water protection. But the measure is well implemented (information campaign, efficient advisory tools). All key partners are involved in the whole policy process and feedback is also collected from farmers. Informal rules do not play a significant role in this policy design/implementation.
Recommenda-tion	There is limited scope for increasing the effectiveness of the measure. This could be done by a precise design of the soil erosion prevention measures. However, the potential for improvement is limited by difficulties in the control of some of the technical measures. It is recommended to solve the main part of the soil degradation by other policies and use Nitrate Directive as a complementary measure rather than trying to promote its role in soil protection. Because soil and water protection are closely related, erosion protection on specific key localities for water protection should be further pursued. This should be done in a way this does not increase unnecessary administration burden for farmers (as simple as possible).
Part B – Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The policy was designed by MoA with substantial support of several organisations: VURV, VUMOP, UKZUZ. There are several organisations which are consulted during the process of the design e.g. MoE, regional governments, farmers' organisations. In general there is efficient and effective participation of key organisations in policy design. Representatives form a working group which develops and assesses the policy.
Policy imple-mentation I: Implementa-tion at admi-nistrative level	The policy is implemented at the national level and controlled by UKZUZ at the local level.
Policy implementa-tion II: Method of delivery to farmers	The Nitrate Directive was implemented with a massive information campaign targeted at farmers by using seminars in regions, leaflets, internet and other means. An internet-based advisory tool was developed using LPIS as the first layer to which the management of each field is attributed according to type of soils, slope, proximity to water bodies, etc. The tool is available to all farmers because they have access to their fields in LPIS. The information transfer is managed by UZEI.
Targeting	The measure is highly targeted, because it reflects the local conditions in the site-specific management.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? ⊗ □ □ □ □ Low High

What Drives Uptake?	Uptake is driven by fear of penalties. Now the first action program is implemented and sanctions were not used so far.
	⊗ Obligation □ Financial incentive □ Information & support □ Exhortation □ Other
Technical measures	There are no technical measures defined.
Enforcement and control	The compliance to the Action plans in NVZs is controlled by UKZUZ, the control is done on site and the sample (5 %) is defined by a risk analysis. Relevant rules are also required as a baseline for agri-environmental measure, LFA and direct payments (this is enforced by the Paying Agency – SZIF). The Czech Inspection for Environment plays a partial role in the enforcement and control.
Monitoring and evaluation	Only the first Action plan was implemented in the Czech Republic and therefore evaluation has not been undertaken so far. The responsible body for evaluation is MoA. The feedback from research institutes and from farmers is already used for the amendments.
Outcomes of policy measure	So far the control organisation did not indicate many cases of non-compliance to the Action plans in NVZs.
Analysis of drivers of policy measures' outcomes	The main driver of the outcomes is the fear of penalties, the well-managed information campaign and information transfer (including advisory tools).
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	When considering the speed of investment in the relevant facilities (storage of manure) then the measure is effective. It is not possible to indicate how the measure is effective in erosion prevention, but a low rate of non-compliance lets us assume that the measure is also effective in this sense. It should be stated that the basis for such an assessment would change after the more demanding requirements are amended. It is expected that the compliance to the new rules will be more difficult (e.g. longer storage period). The measure is regarded as cost effective.
Constraints to achieving full potential of the policy measure	Given the nature of the measure it was regarded that it is difficult to address soil erosion with its diffuse nature (in cases where no severe damage occurred) and at the same time to find a feasible control approach. Still there is no information on soil erosion in required detail for the whole national territory for that purpose.
Reasons for the success of the policy measure (where appropriate)	Farmers are rather well informed, and relevant organisations and farmers cooperate quite well.

The consultation process used in the design of policy measures mentioned above (in particular fiches 1-3)

In most cases the policy is designed and amended by working groups lead by the relevant ministry. The working groups are usually composed of representatives from the ministry, research institutes and universities, and in some cases, representatives of farmers' organisations. Documents produced by such groups are subject of consultation.

The government issues the list of organisations to be included in consultation. There is one list of organisations which comments should be incorporated (if classified as substantial). These are for example ministries and regional governments. Comments of organisations from the second list are treated in a somewhat different way. If these are not accepted, this should be explained. Organisations from the second list are for example universities, research institutes, farmers' organisations, and other NGOs).

Comments on cross compliance GAEC standards

Cross compliance GAEC standards – Good agricultural and environmental conditions: It is compulsory for Member States to implement GAEC standards that also contains soil conservation measures as a part of cross compliance. Those in the Czech Republic do not represent significant demands for farmers and are close to the current farming practice. Initiatives to amend the measure failed so far. But the potential of this measure is so high that several interviewees claimed this measure to be very important and that it should be amended. The amendment of the measure is envisaged in the near future by means of introducing more demanding conditions.

7.3 Summary of policy use and effectiveness

The farmers identified the following soil degradation problems (in order of severity): 1. Soil erosion (water), 2. Retention capacity of soils, 3. Off site damages, 4. Decline of soil organic matter, 5. Carbon balance. Experts identified as the most serious issue soil erosion caused by water, as a second soil compaction and third decline in organic matter.

Several policy measures are expected to respond to the soil degradation. The following key policies were identified in the case study area:

Command and control type:

- Law 344/1992 on Soil Protection.
- Nitrate Directive, which was implemented in the Czech Republic as the Directive on Designation of Nitrate Vulnerable Zones and on use and storage of fertilisers and farm manure, crop rotation and erosion prevention measures in these areas No. 103/2004.
- Law No. 185/2001 on Use of Waste (including sewage sludge).
- Cross compliance GAEC standards as a baseline for direct payments, AES and LFA.

Project based type:

- Land consolidation

Incentive instrument:

- Agri-environmental schemes: conversion of arable land to grassland and growing of cover crops.

The policies with the most significant influence in soil protection are the Law on Soil Protection, the Nitrate Directive, Agri-environmental schemes and Land Consolidation. Some experts regard land consolidation as the most important policy measure, but when considering responses of other interviewee and the prime focus of each policy measure it is not possible to say which is the most important because they are complementary. It is possible to indicate which measures are not so important (e.g. Nitrate Directive) because soil

protection is not the main focus of this policy, or GAECs which are designed in a way that they are not effective despite their rather significant potential.

Law on soil protection. This is a command and control type of policy. The law provides a framework for protection of land and soil respectively from permanent loss and from decline in quality.

The rules for protection of soil that prevent it from permanent loss (e.g. sealing) are enforced rather well but are not far-reaching enough to prevent losses in case of major development projects (especially in urban fringe). One of the reasons could be that there is a conflict of interests in the administration, where the rules are enforced (at municipality level or regional level). Usually the administration has an interest in the economic development of their region and large development projects are promising in this sense. Therefore it happens that the officer responsible for enforcement of the rules is asked to approve the application for use of agricultural land as construction site by his superior. In some cases developer organisations buy agricultural land in advance in a strategic place and claim that it is in the interest of the municipality to allow further development there (e.g. shops, factories or housing).

The law is even weaker when assessing its power to prevent soil degradation. An important factor is actually the nature of the issues. For the majority of degradation types it is extremely difficult or costly (or both) to prove the causal link between a particular farmer's actions and subsequent effects. These high transaction costs weaken the effectiveness of the law. Another example is when extreme weather conditions cause erosion that is not possible to prevent at all. For cases of apparent failure of farmers in preventing erosion the law also does not provide enough power (e.g. penalties are not well defined). Therefore the rule does not have deterring effect i.e. farmers do not have fear from penalties. As a result the law is not effective in prevention of even those apparent and extreme cases of land/soil damage. Only in rare cases it provides enough power to administrations to force guilty farmer to deal with consequences of external damages (e.g. erosion leading to off-site economic losses). In this case the property rights are much stronger than public interest expressed in the law. The relevant governance structures are rather sufficient to fulfil their role but weakened by conflict of interests. The measure is relevant for the soil/land protection and should be improved regarding its enforceability.

Nitrate Directive and related Czech legislation. This measure has the primarily objective of water protection and therefore it is not expected to achieve similar outcomes as from measures targeted at soil protection. The impact of the measure was not tested yet but it is assumed that it is not a major contribution to soil protection. The reason is that the Czech administration did not find a way how to design effective and at the same time enforceable technical measures to prevent erosion close to water bodies in Nitrate Vulnerable Zones (NVZs). Even if the measure is successful locally the effect is concentrated only in a small proportion of the land and is not sufficient for soil protection at national level or even the case study area level. All questioned farmers reported that they comply with the requirements of the Nitrate Directive on their farms. The measure is particularly relevant for specific localities in NVZs, its design should be improved in order to increase its effectiveness and enforceability, i.e. more targeted and precisely described for soil erosion prevention.

GAECs. This measure is not demanding and therefore not very effective, but has high potential when redesigned. For example there is a limit of growing row crops on slopes over 13.3 %, while there is a need for exclusion of row crops from 7 %. It means the measure is not effective while having a large potential for soil protection. The recommendation is to redesign this measure and to make the limits more demanding.

It is assumed that a significant proportion of slopes has been converted to grassland during the last 15 years. This happened also in the upper part of the case study area where in the past the Water Authority negotiated with farmers and supported them to apply this measure. Financial support for this activity is not available anymore but personal contacts with farmers are still nurtured. Most of the questioned farms still adhere to this scheme (6 out of 8 farms).

Land consolidation. This project-based measure has the main objective to consolidate property rights (e.g. access to fields, identification of titles, reorganisation of fields e.g. concentration of fields from one owner on one place). The relevant law requires the design and implementation of permanent changes in the arrangement of fields and the introduction of so-called “common facilities” which include also field banks, bio-corridors, conversion of arable land to grassland, dry polders, field roads, etc. These landscape features should be designed in a way that is favourable for soil protection and experts on soil erosion prefer them because most of them are permanent. The nature of the process of land consolidation requires reaching consensus on proposed changes in the cadastre and therefore in some cases again property rights are stronger than some of the proposals (especially conversion of arable land to grassland) and these are not agreed in many cases. Another disadvantage of this measure is that this is very demanding process both in form of financial sources and personnel.

Therefore significant impact on national/case study level is expected in decades because the process of implementation takes so long time. Governance structure is effective despite its efficiency is decreased by too centralised decision making. Long term this is very promising measure which could solve significant part of the problem. The measure is relevant for the soil/land protection and should be improved in a sense of higher requirements to project managers (observing methodology guidance) and by speeding up the process e.g. more personnel and financial means spent on “common facilities” (e.g. tree belts or windbreaks).

Agri-environmental schemes. Both schemes i.e. a) conversion of arable land to grassland (CAG) and b) growing o cover crops (GCC) are supported in the framework of the Rural Development Plan.

The conversion scheme is rather targeted but it is too demanding for farmers to convert arable land to grassland for five years because potentially high opportunity costs are involved. Therefore the uptake cannot be sufficient and several slopes suitable for grassland are still arable land.

Growing cover crops is not as targeted as the previous scheme and it is not applied on the same field every year. Therefore its effect is short term. Its influence is assumed to be significant because most of the visited farms in the case study areas applied for this measure. However, no measurements have been carried out. The measure is relevant for soil protection and should be improved, especially regarding its targeting and its link to advisory service which is currently missing.

General comments. Soil degradation is mitigated by soil conservation measures in the case study area and especially by conversion of arable land to grassland. Adoption of this technical measure was partly initiated by the Water Authority in the past in upper part of the watershed. This represents a truly targeted and purposeful implementation of this measure and the Water Authority played took over the role of the missing extension service.

A large proportion of interviewed administrators did not know enough about soil protection policies and about level of key soil degradation issues in relation to the measure they administer. It could be assumed that this may cause a lack of motivation in pursuing some of the measures. The majority of respondents did not know most of the Czech soil conservation policies. This is sign that there is high specialisation in work for soil conservation.

Typical NGOs are not involved in the design of policies. However, a few of them are invited to consult or claim to be consulted on proposals for spatial planning and conversion of agricultural land for other purposes (e.g. for construction) at the local level. NGOs’ capacity to influence the process as well as their expertise for assisting the soil conservation policy design is low. NGOs have had a short history in the Czech Republic. They are rather locally organised and lack the experience with consultation process.

The knowledge on environmental issues was in general poor among farmers and prove that extension services are missing and that available advisors do not cover these issues.

All stakeholders perceived all measures in general as suitable for soil protection but stated that some of the measures are not well designed, implemented or enforced. Especially weak was design of Law for soil protection and GAECs and these two were seen as not effective. In case of AES, Law for soil protection, GAECs and soil protection in general it was revealed that extension service is missing. Further constraints to implementation were identified in the case of land consolidation and these are the lack of personnel and financial means for "common facilities" building (e.g. field roads and banks, bio-corridors, grassland strips). In case of landscape consolidation inflexible management was recognised, e.g. too much responsibility in the central office.

More widespread uptake of demanding AES could be achieved if extension service is provided and services are promoted. As examples, the failure in uptake of the scheme to introduce grassland strips across the fields to prevent erosion can be attributed to the lack of information and advice. There was no partner for farmers at the local level. In contrast, implementation of feeding strips for wildlife is a rather successful measure and uptake is growing because farmers have partners providing advice, in this case members of the Hunting Association.

A major gap is that none of the policy measure has a procedure leading to detailed evaluation of its impact on soils. The relevant studies are rare. Therefore it could be assumed that the learning in the policy cycle is limited.

The majority of respondents did not name any measures as best practice. A few respondents indicated that land consolidation could be regarded as the best practice. However, this does not apply to the measure in general but rather to certain projects, which were implemented well and tell a success story. In addition, other measures were rarely named as best practice (e.g. agri-environmental schemes and rules under Nitrate Directive). It could be concluded that land consolidation could be potentially regarded as best practice provided that those projects are selected which were designed and implemented according to prescriptions. The reason is that the framework of this process is rather well designed and the process of implementation is based on the consensus of key actors and stakeholders. Therefore usually some solution is found and permanent technical measures are implemented. Land Consolidation is creating a permanent structure thus positively influencing the application of other technical measures.

The soil degradation processes in the case study area are not fully covered by soil protection policy measures. All measures have some gaps which hinder their full performance in soil protection. Some types of degradation are not covered at all such as soil compaction and decrease of organic matter in soil.

There is a need for an integrated strategy for soil conservation at national level, which could help in coordination and targeting of all measures.

Soil protection is not a top priority in most of the relevant organisations.

New institutions/governance structures/incentives:

All those kind of policies are not new and were implemented earlier in several countries. In most if not in all cases the measures were implemented by already existing authorities, or new responsibility was transferred to them (e.g. Land Settlement Board and land consolidation). In general no new organisation was established for the purpose of implementing soil protection policy.

We conclude that all policies should be implemented with similar rules (e.g. information provision, training, effective enforcement and control). However, voluntary economic instruments (agri-environmental schemes) or project and development measures need special attention to assure participation such as persuasion, teaching about the effects of a policy. This is based on the assumption that participation in agri-environmental schemes should be an active decision while command and control measures require more passive participation of the relevant actors.

Regarding future trends it is expected that new instruments will be designed in the framework of the Water Framework Directive while the Law on Soil Protection is under a process of amendment.

8 Conclusions

The soil degradation problems are highly relevant for the area because there are two drinking water reservoirs and which make soil erosion a major concern (drinking water dams with lot of silt).

The most effective measure is land consolidation but budgetary limits prevent the implementation of a sufficient number of such projects. In addition, the process is lengthy and it could take number of years to build all necessary permanent erosion prevention measures (e.g. field banks, wind brakes, grassland strips across slope). No serious failures in implementation were found in this particular area. The general problem is the limited availability of information (e.g. dissemination, education) especially to small farmers on national level (not enough funding and especially not enough well trained full time advisers).

A lot of knowledge exists and is available on the issue of soil erosion or more in general the state of the environment.

Gaps in knowledge and empirical material concern the exact location of some measures (location of agri-environmental schemes for example), and a lack of studies on the real impact of all measures.

The Czech conditions in farming are characterised by large mixed farms with large fields where most of the land is rented. The ownership is distorted by decades of communism when individual fields were merged into large blocks. Property rights are weakened by limited or no access to fields and the owners' limited possibility to release individual blocks for sale (if blocks are inside large fields). Therefore, there is to some extend high power of land managers over landowners. This is one of the barriers on the land market in the Czech Republic. One of the outcomes is that the land is not treated as a heritage and resource for future generation but as another mean of production without specific characteristics (e.g. that it is non-renewable).

Main causes of soil degradation are using large fields while not respecting slopes and large machinery not used according to specific characteristics of some parts of the fields or timing. The main types of soil degradation are soil erosion, compaction, decline of organic matter and carbon content. As a result there is high water runoff and off-site damages.

It was revealed that there are no specific measures in the case study area but it shares policies with the whole national territory. The only exception was the policy of the Water Authority which in the past invested in compensation payments and persuaded farmers in the upper part of the watershed to convert the most sensitive arable fields to grassland. This policy is not applied anymore.

Overall land consolidation is currently regarded as the key policy tool for soil conservation because it introduces permanent changes to the landscape, which are essential for soil protection (e.g. field roads, field banks, bio-corridors, grassland strips). The disadvantage of this measure is that it is rather demanding and it will take decades before such projects are implemented in all cadastres. In addition this measure is not suitable for the introduction of certain farming practices (e.g. exclusion of row crops from slopes) but rather suitable for permanent changes as mentioned above. In general the measure is functioning quite well, in cooperation of all key stakeholders and could be seen as a good example of soil conservation measure.

One of the main failures was that for a long time land consolidation was not a priority and the relevant administration lost its power and financial resources. This was overcome after the elections when the leadership of MoA reinstalled this priority and gave back the previous power and responsibility to the Land Settlement Board.

Nevertheless, land consolidation is frequently not sufficient to prevent soil degradation. There should be other instruments with a preventive role such as formal rules.

Such rules are designed in the Law on Soil Protection but these are not enforceable to prevent soil degradation and rarely are used to push farmers to fix off-site damages caused by soil erosion. There is a serious need to have such legislation, which is easy to enforce and able to prevent major degradations and off-site damages. But the difficulties of tracing off-site damages and softer degradations to the actual failure of farm practices should be taken into account (trying to enforce rules for such cases could implicate prohibitively high transaction costs). The role of the Law on Soil Protection is also to protect land against non-authorised use for other purposes. Relevant rules are implemented and are weak only in cases where there are other strong interests such as large construction (with sometimes disputable social benefit). Organisational change should be introduced either to give more independency to relevant officers or to control relevant municipalities or regional governments regarding conflicts of interest. The fees for converting agricultural land to non-agricultural land should be higher in order to increase its deterring effect. This issue is already under discussion by relevant bodies.

AES and land consolidation encourage the right practices (e.g. cover crops are accepted). Nitrate Directive requirements have a positive impact on soil as a by-product. There is no significant impact of GAECs on soil degradation mitigation.

Effectiveness and efficiency of investigated policies is limited by several factors: 1. failure in policy design phase (e.g. not demanding schemes, not sufficient targeting), 2. failure in implementation phase (e.g. lack of advice on soil protection), and 3. evaluation is neither designed in the initial phases of the policy process nor conducted to provide information for policy improvement and learning of the whole system. For policy success it is important to undertake proper analysis of potential effects and planning of future policy steps which in the Czech case was not undertaken sufficiently (Hogwood and Gunn, 1984).

Current policies encourage only some needed farming practices. Especially arable land conversion to grassland and cover crops are financially supported. Under the land consolidation process permanent landscape features are built (see chapter 5) and some soil conservation practices are proposed but rarely enforced. Some soil conservation practices are not supported effectively by any policy in the Czech Republic. These are for example (including possible measures introducing them):

- Exclusion of row crops on slopes over 7 % (GAECs).
- Grassland strips across the slope (interrupting long slopes) and grassland waterways (land consolidation and AES).
- Strip cropping i.e. changing different crops across the slope (land consolidation and AES).
- Tillage practices enhancing organic matter in the soil (GAECs).

In order to increase the effectiveness of current policies there should be improved communication and finding of common interest between MoA and MoE by mediation (especially for the Law on Soil Protection). Land Consolidation is going to be improved in the near future as its priority increased recently. Targeting of AES and more effective design for erosion prevention under Nitrate Directive should be improved at MoA.

MoA is responsible for the advisory service, which is missing in case of soil protection in general and therefore the change should be done at this level.

In general it should be helpful to agree some limits for soil erosion to enhance enforcement and self-control of farmers by introducing more information on soil erosion to LPIS, the information system available to farmers.

As mentioned above there is ongoing political effort to amend the Law for Soil Protection and the land consolidation process is going to be supported more than before. New measures are envisaged for soil protection under Watershed Plans in the framework of the Water Framework Directive.

Farming and land use are changing slowly in the Czech Republic these days, especially in comparison to the 1990s. There is a parallel process of fragmentation (breaking down of large corporate farms to still quite large farms) and concentration (e.g. merging of already large farms). Improvement of efficiency in farming leads to a decrease in the numbers of dairy cows. At the same time there is still a tendency for increasing numbers of beef cattle. It is expected that higher prices of cash crops would negatively influence the willingness of farmers to convert arable land to grassland instead it is likely that grassland could be ploughed and converted back into arable land. If the prices stay high it could support further specialisation of farms e.g. more farms could focus only on arable farming.

As a way of conclusions it could be stated that because of diverse types of soil degradation with different nature and different degree of complexity of causal links between farming and particular degradation, both regulatory and voluntary measures should be implemented and designed in a balanced way.

Suggestions:

- A national soil protection strategy should be designed in order to give each measure specific goals and to project integration of the whole soil conservation policy.
- All measures should be supported by advisory services (rules under Nitrate Directive are already advised well).
- For all measures mechanism for the evaluation their impacts should be in place.
- The Law on Soil Protection (and/or its lower legislation) should be revised in order to be enforceable. It means the wording should clearly describe the damage and the way of enforcement. Organisational changes should be adopted to exclude a possible influence of decisions on land protection by superiors at the municipality/regional government level. The fees collected when agricultural land is used permanently for other purpose should be higher.
- Land consolidation process and its “methodology” (guiding prescriptions) for project managers should be more demanding to ensure that all key measures for soil protection are proposed by project managers and regional Land Settlement Boards should enforce this requirement. Land Settlement Boards need more personnel and financial resources for Common Facilities (e.g. technical measures preventing erosion) to keep the momentum of the land consolidation process.
- Agri-environment schemes should be more targeted at vulnerable soils (e.g. on slopes). Management of the measure should be improved (e.g. to give more time to farmers to learn about AES and for delivery of application forms).
- Nitrate Directive rules are implemented quite well. However, the design for erosion prevention does not reach its potential. It should be designed in a way to prevent at least the most severe cases of soil damage (e.g. gully erosion) that are easier to prove.
- GAECs should be redesigned substantially. Provisions should be added concerning the protection of soil against the most severe damages (e.g. again gully erosion, erosion with off-site effects.).

The results of the survey show that current policies do not respond fully to the needs for soil and land protection. Some issues are not addressed at all (e.g. soil compaction, organic matter) and major degradations such as soil erosion are not addressed sufficiently.

There is a lack of coordination among MoA and MoE policies regarding design and implementation.

There are no local initiatives dealing with soil conservation. However, there is a limited number of farmers (family farmers and farm corporations) who introduce soil protection measures. The only NGO that has the capacity to play such a role at the local level are Land Trusts, but these are presently focused only on nature protection.

The most needed improvement is in land ownership (fragmented ownership and concentrated land management). But this represents institutions, which cannot be changed in a course of next few years and this long-term process should be persuaded by state policy by creating favourable conditions for this desirable change.

Another possible side effect of development of land ownership is lack of understanding of the value of land as a natural resource and the need for the protection of its quality. As a result soil protection has a low priority in several administrations dealing with relevant policies and it is difficult to agree on policies and rules, which could be enforceable and could support the growth of responsibility for soils among land managers and land users in general. One of the ways to deal with the issue is purposeful work with information, training, and awareness rising.

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Annexes

Annex 1: Overview of the results of Questionnaire 1

Main farm types	arable, livestock
Main crops	winter wheat, rye, barley (spring), potato, rape, maize (fodder)
Livestock	bovine (races: Charolay, Holstein)
Main production orientation	conventional
Average field size	15 ha
Irrigation methods	no irrigation
Source of irrigation water	n/a
Usual salt content of irrigation water	n/a
Drainage systems	tube system and ditches
Existing grass strips	yes
Separation of fields by hedges	no
Main soil degradation problems	soil erosion water, decline in organic matter, soil compaction, decrease of water-retention capacity, off-site damages
Applied soil conservation measures (cropping/ tillage measures)	intercrops, undersown crops, grass strips, reduced tillage, contour tillage, restriction of row crops on steep slopes, wheel sizes and pressure / restricting excessive heavy machinery use, restrictions on the max. amount of (liquid) manure application, restrictions of manure application to a certain time period, restrictions on the max. amount of N- fertilisation, restrictions on the max. amount of P- fertilisation
Applied soil conservation measures (long term measures)	change of crop rotation, liming, change of field patterns and sizes, retention ponds, subsoiling, adjusting duration and season of grazing animals

Annex 2: List of interviews – Q 3

Interview Date	Interviewee (affiliation/position)	Type of interview
21.4.	MoA, head of department	Personal
2.5.	MoE, dead of department	Personal
12.5.	MoA, Axis II officer	Personal, part telephone
16.5.	Paying Agency, regional office	Personal
29.4.	Paying Agency, central office, head of department	Personal
26.5.	MoA, Nitrate Directive officer	Personal
23.5.	Regional government, dead of department of environmental protection	Personal
30.5.	MoE, officer for soil protection	Telephone

26.4.	Minister advisor	Personal
13.5.	Land Settlement Board, dead of unit	Personal

List of interviews – Q 4

Interview Date	Interviewee (affiliation/position)	Type of interview
25.4.	Agricultural Chamber, regional office, manager	Personal
25.4.	Regional information centre, head of the office	Personal
28.5.	Technical university, researcher, expert	Personal
24.4.	Morava river Water authority, head of department	Personal
26.4.	Association of family farmers, manager for international affairs	Personal
23.4.	Research institute of soil and water protection, expert on soil protection, head of unit	Personal
29.4.	Regional centre of advisor's support, chief advisor	Personal
25.4.	Agricultural Chamber, regional office, vice-president	Telephone
20.5.	Research Institute of Agricultural Economics, expert on land consolidation, researcher	Personal
27.5.	ARNICA, NGO, person responsible for soil protection issues	Personal

Additional Qualitative Interviews:

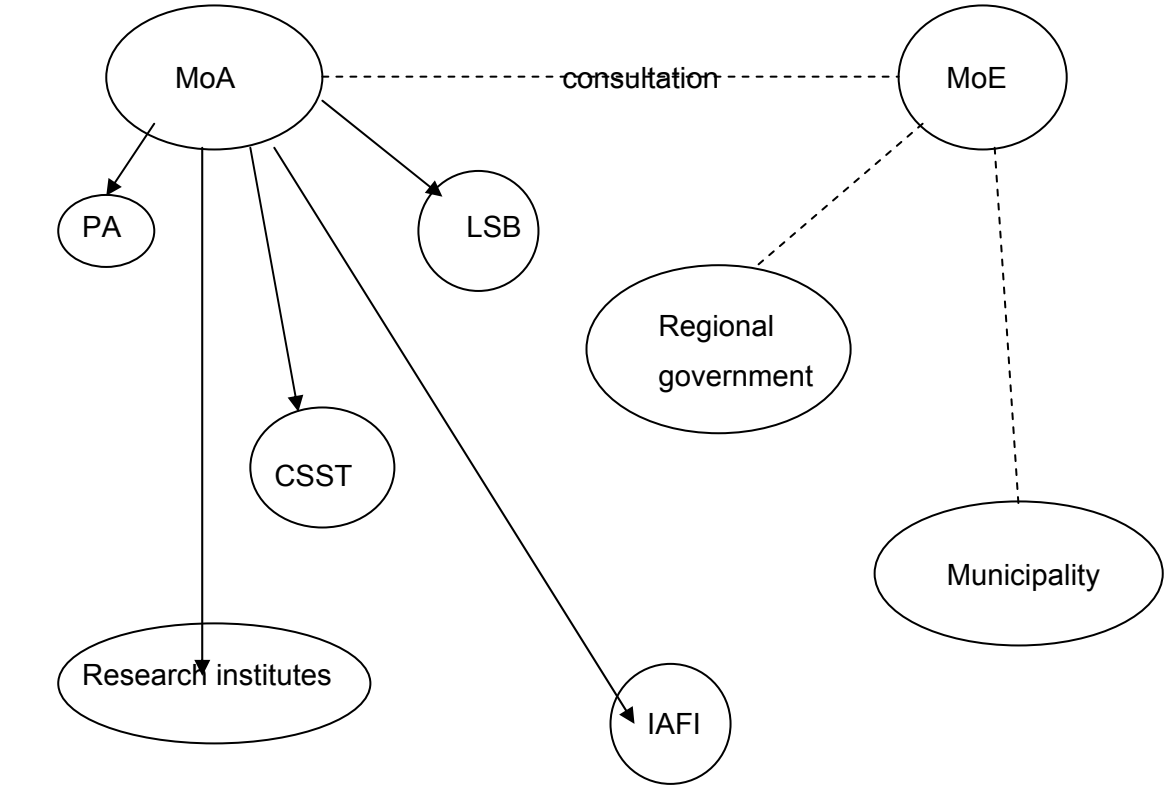
Farmer: director/agronomist, 23.1.2008

MoA: Land office, head of unit, 22.1.2008

Watershed Morava Authority: head of relevant unit, 21.1.2008

Land office – Zdar nad Sazavou: Land consolidation unit, 21.1.2008

Annex 3: Structure and links of key organisations acting in soil protection in the Czech Republic



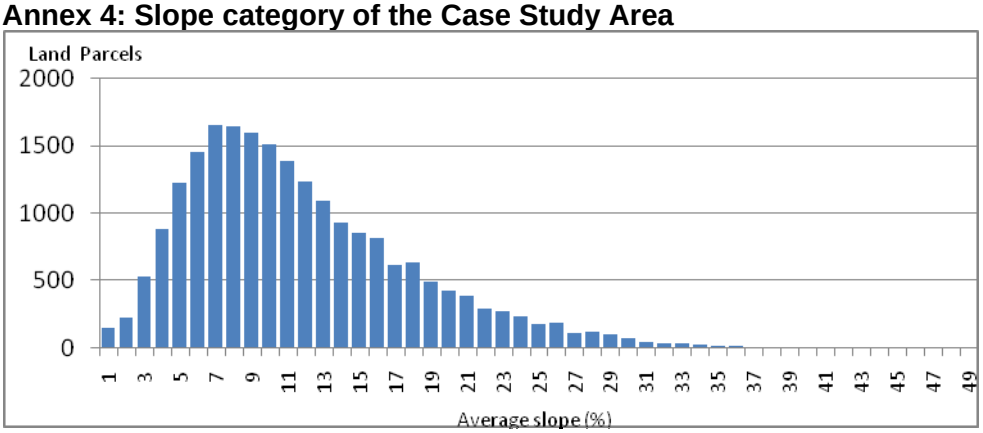
Ministry of Agriculture (MoA), Ministry of Environment (MoE)

Regional governments, Municipalities with extended competence, Agricultural Agency and Land Settlement Board (LSB)

Research Institutes, Central Institute of Supervision and Soil Testing (CSST)

Paying Agency, Institute of Agricultural and Food Information (IAFI),

Annex 4: Slope category of the Case Study Area



Source: DME analyses

Annex 5: Glossary of policy measures

English title of policy measure (law, regulation, initiative)	National title of policy measure
Law on Land Consolidation and Land Settlement Boards No. 139/2002.	Zákon č. 139/2002 Sb. O pozemkových úpravách a pozemkových úřadech, ve znění pozdějších předpisů.
Law on Land Consolidation and Land Settlement Boards No. 309/2002.	Zákon č. 309/2002 Sb. O pozemkových úpravách a pozemkových úřadech.
Law on Fertilisers and other soil substances, plant substances and soils and about agro-chemical testing of soils as amended later (Law on fertilisers), No. 314/2004.	Zákon č. 317/2004 Sb. o hnojivech, pomocných půdních látkách, pomocných rostlinných přípravcích a substrátech a o agrochemickém zkoušení zemědělských půd (zákon o hnojivech),
Law on Soil Protection, No. 334/1992 as amended in later legislation	Zákon 334/1992 Sb. o ochraně zemědělského půdního fondu, ve znění pozdějších předpisů.
Directive on storing and way of use of fertilisers as amended later, No. 247/1998	Vyhláška č. 274/1998 Sb. O skladování a způsobu používání hnojiv, ve znění pozdějších předpisů
Directive on Designation of nitrate vulnerable zones and on use and storage of fertilisers and farm manure, crop rotation and erosion prevention measures in these areas No. 103/2003.	Nařízení vlády č. 103/2003 Sb. O stanovení zranitelných oblastí a o používání a skladování hnojiv a statkových hnojiv, střídání plodin a provádění protierozních opatření v těchto oblastech
Directive on conditions for application of processed sewage sludge on land as amended later No. 382/2001	Vyhláška č. 382/2001 Sb. o podmínkách použití kalů na zemědělské půdě ve znění pozdějších předpisů

Annex 6: Compilation of Soil Conservation Measures and Responsible Authorities

Agricultural infrastructure and complex land consolidation. Erosion prevention is supported to a limited extent under programmes of the Ministry of Environment (Operational programme, Programme of soil protection and Programme for nature management). These programmes provide support for similar erosion prevention measures as Complex land consolidation (field banks, grassland strips, dry polders, etc.).

The state company Watershed Morava introduced the strategy "Clean watershed Svratka" which contains the objective to reduce soil erosion in order to prevent water pollution by sediments and nutrients (e.g. by measures such as conversion of arable land to grassland, grassland strips and strips for accumulation of water in ground and system of wetlands). This policy includes the following soil related measures: 1) erosion prevention measures (creation of: field banks, grassland strips across slope or introduced in the water path ways, conversion of arable to grassland or forest, terraces, wind brakes), 2) ecological stability (e.g. strips of wood/shrub, trees planting) and 3) facilities for access fields (e.g. field/forest roads, fords), small bridges, railway overpasses), 4) measures targeted at water management on site (e.g. water reservoirs, ponds, streams changes, drainage, protecting banks, dry polders).

Central government – Ministry of Agriculture (MoA) with its LSB (in cooperation with Ministry of Environment – MoE) are the authorities responsible for the design of the measures.

The Agricultural Agency and the Land Settlement Board (LSB) are formally and actually responsible for the implementation of the measures (especially LSB). Their divisions are actually responsible for particular projects that are designed and implemented in regions.

Land consolidation is an effective measure for soil protection based on law No. 139/2002 on land consolidation and land offices. Corresponding law gives land offices power to implement soil protection measures on land, but: the process should be initiated by owners (or other stakeholders e.g. railway company), the proposals should be agreed by owners and soil conservation projects (e.g. field banks, wind breaks, trees planting) is usually done on state or municipality land. This is possible because fields are totally reorganised in the given cadastre. The LSB has budget (national and EU RD) funding to pay project designers and actual realisation of the projects. The whole process is lengthy, often difficult but participatory to a great degree. All work is performed under contracts and Land offices carry out control and monitoring. At the same time the Paying agency also carries out the control.

Regulation of rural land use. Control over conversion of land to other land use, especially when the land is fully lost as natural resource (e.g. for construction), but also for cases like arable to grass land, agricultural land to forestland, etc. There are objectives (not quantified) to reduce the loss of agricultural land especially in favour of urban sprawl. Listed types of changes of land use have to be approved by relevant authority.
The Ministry of Environment with help of Ministry of Agriculture is responsible for policy design. MoE proposes legislation changes and MoA is one of the most important partners in the consultation process in which all key stakeholders are invited to comment. MoE makes the final decision.

Regional governments approve changes in land use on more than 1 hectare. Municipalities have responsibilities at two levels: 1) municipalities with extended responsibilities approve changes of land use up to 1 ha, 2) rest of the municipalities play limited role in control of the soil protection (they have limited power and do not use it).

The owner of the land who wants to change its use should apply for such a change to the relevant planning authority. The development project is first consulted with relevant divisions of the regional government such as nature protection, soil protection, and water protection divisions. In case the change leads to loss of the agricultural land and it is approved a fee is

collected. The process has a hierarchical form. The most sensitive changes of land use are: grassland to arable land, agricultural land to non-agricultural use (e.g. construction site).

Waste regulation - Sewage sludge spreading rules. There are general objectives in respect to the reduction of waste and its proper management and no specific rules for this particular area (except stricter rules in drinking water protection zones in proximity of water resources). In addition, there are limits of content of particular substances (e.g. heavy metals) for sewage sludge and upper limit of amount of applied sewage sludge on agricultural land. These rules are designed by researchers and finally decided by MoA at national level.
The Central Institute for Supervising and Testing in Agriculture is responsible for the enforcement and controls the actual content of certain substances in sewage sludge before application and in soils. This is the tool pursuing farmers to apply the sewage sludge only on approved sites, of certain quality of sludge and in approved quantities.

Water regulation - Nitrate directive. This directive mainly refers to nutrient management. There is general national level objective to reduce contamination of ground and surface water from agricultural resources. The target is cascaded to the case study region but the targets are not further specified in this region. Only a relatively small proportion of the case study area - the upper part of watershed – has the status of a nitrate vulnerable zone (NVZ). This status imposes limits in the application of nutrients, the timing of the application of nutrients and limits concerning slopes, the type of manure and the period of the year for application of manure.
The measure is decided by the Ministry of Agriculture (national level) in consultation with MoE (which is responsible for designation of the NVZs) and with support of the Water Research Institute and Crop Research Institute (and other research institutes).

The Central Institute for Supervising and Testing in Agriculture is responsible for enforcement, which means it controls observation of the rules on site. In case of non-compliance sanctions are applied. The Crop Research Institute and the Institute of Agricultural and Food Information (agricultural extension organisation) help in dissemination of information among farmers.

Agri-environment incentive policies. Agri-environment measures and other measures under the rural development programme are part of national policy and therefore there are no specific objectives concerning the case study region. Agri-environment measures are an appropriate tool for achieving the general objectives of the case study area: reduction of water pollution caused by soil erosion and nutrients loss. Soil related measures include land consolidation projects, planting energy wood and forest as well as agricultural measures such as organic farming, integrated production methods, extensive grassland, and conversion of arable land to grassland, and cover crops over winter.
The final decision is in hands of MoA with intensive consultation with MoE and other stakeholders (e.g. NGOs, research institutes, regional governments). Agricultural Agencies and Land Settlement Boards (LSB) are responsible for the application process and administrative control. The Paying Agency is responsible for controls and sanctions (sanctions decided together with MoA in ambiguous cases). The Institute of Agricultural and Food Information helps in dissemination of information among farmers.

The Paying Agency handles contracts, execute payments, run controls and collect sanctions in case of non-compliance with contracts. Approving contracts, executing payments, decisions on sanctions are decided on national level. The rest (e.g. controls on spot) is done on regional level by the Paying Agency. The MoA supports the Institute of Agricultural and Food Information (agricultural extension organisation) in the dissemination of information among farmers. Common methods are seminars, website, booklets and training of advisers.

Cross-compliance (GAEC). There are no specific soil related objectives concerning cross-compliance for this case study region. Soil related measures include the protection of landscape features (field banks, avenues, terraces, trees), no row crops on slopes more than

12 degrees, liquid manure should be ploughed in not later than 24 hours after spreading, no conversion of grassland to arable land, and plant residues must not be burned.

MoA is responsible for final decision on the measures (on national level), with close consultation with MoE and other stakeholders. The Paying Agency implements the measures and undertakes controls on spot at the regional level using LPIS in relevant cases. In cases of non-compliance direct, LFA and Agri-environmental payments are reduced (in proportion to level of non-compliance). Decisions on sanctions are made on national level.

Good agricultural practice measures have been replaced by cross-compliance and in case of the Czech Republic by GAECs.

Training/advice. There are no specific objectives for the case study area concerning training/advice. Advisers are trained in the following topics: Cross-compliance, protection of permanent pastures, Natura 2000, agri-environmental measures, and environmental measures in forestry.
The training strategy is designed at the Institute of Agricultural and Food information (agricultural extension organisation) and approved by MoA, both on national level. The Institute of Agricultural and Food Information (IAFI), with help from the Research Institute of Water and Soil Protection, is responsible for implementation of the measure.

IAFI (extension organisation) receives support from MoA which approves projects for dissemination. Advisers are trained centrally (on national level) and receive certification for particular topics (see above). Farmers are eligible for support from government to hire advisers for public goods advice including water protection and cross-compliance (e.g. including erosion prevention measures and nutrients management). However, overall soil management is not a main focus of the advice provision and state support.

The Research Institute of Water and Soil Protection has a key role in developing methodologies for design and implementation of soil prevention measures. Those instruments are used by all designers of the Complex Land Consolidation projects.

Agricultural policy measures. There is a general national level objective to prevent grassland damage. This is specified to a limited intensity of production, i.e. the maximum stock in LFA support is 0.2-1.5 GU/ha.
MoA designs the policy and makes the final decision on the policy in close consultation with MoE and other stakeholders such as farmers and their representatives, research institutes and the Paying Agency.

The Agricultural Agency handles the application forms, undertakes the administrative control and passes information on to the Paying agency (which actually implements the measure), which approve the application and create the contract, pay the support and carry out on spot controls (the last on regional offices).

Soil monitoring. The goal is to monitor selected indicators of soil quality (e.g. nutrients, pollutants, etc.) by means of soil testing in network of sampling points. The approach is designed at the Central Institute of Supervision and Soil Testing (CISST) in Agriculture and approved by MoA. ISST implements the measure. CISST collects samples and test soils on several indicators of soil quality. This state organisation is supported by MoA and operates on national level. It has administrative power (e.g. on spot controls on manure storage and some GAECs) to decide on sanctions to farmers when non-compliance is found. In addition, CISST undertakes tests on the responses of crop to fertilisers.

Sanctioning system. Sanctions are designed by the relevant controlling body and usually approved by MoA. The Institute of Supervision and Soil Testing in Agriculture is responsible for sanctions referring to nitrate directive measures, while the Paying Agency enforces cross-compliance and contracts under the Rural Development Plan (e.g. agri-environment schemes, LFA).

The Central Institute for Supervising and Testing in Agriculture operates on national level (with a few regional branches). It has administrative power (e.g. on spot controls on manure storage and some GAECs) to decide on sanctions to farmers when non-compliance is found. The Paying Agency has regional offices, which carry out on spot controls and reduce the level of payments (decided on national level), when non-compliance to cross-compliance or the content of the contract (e.g. LFA, agri-environment schemes) is found.

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Abstract

This Technical Note 'Case Study – Czech Republic' is part of a series of case studies within the 'Sustainable Agriculture and Soil Conservation' (SoCo) project. Ten case studies were carried out in Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Spain and the United Kingdom between spring and summer 2008. The selection of case study areas was designed to capture differences in soil degradation processes, soil types, climatic conditions, farm structures and farming practices, institutional settings and policy priorities. A harmonised methodological approach was pursued in order to gather insights from a range of contrasting conditions over a geographically diverse area. The case studies were carried out by local experts to reflect the specificities of the selected case studies.

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